MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. LII. JUNE 10, 1892. No. 8

E. B. KNOBEL, President, in the Chair.

The Rev. James Baikie, Glenview Terrace, Barterholm, Paisley, N.B.;

John Dansken, F.S.I., 4 Eldon Terrace, Partick, Glasgow;

Henry Daniel McCarthy, 5 Promenade, Cheltenham; and

Martin Charles Sharp, M.A., 5 Portman Street, Portman Square, W.,

were balloted for and duly elected Fellows of the Society.

The following candidates were proposed for election as Fellows of the Society, the names of the proposers from personal knowledge being appended:—

John A. Brashear, Astronomical and Physical Instrument Maker, Allegheny, Pennsylvania, U.S.A. (proposed by W. H. Maw);

Walter William Bryant, Assistant, Royal Observatory, Greenwich, Seymour Cottage, Conduit Vale, Blackheath, S.E. (proposed by W. H. M. Christie);

Captain James Fisher, 7 Fenchurch Avenue, E.C. (proposed by Capt. P. Thompson);

Thomas Charlton Hudson, Assistant, Royal Observatory, Greenwich, 88 King George Street, West Greenwich, S.E. (proposed by W. H. M. Christie);

Francis R. Wardle, Banker, 43 Moorgate Street, E.C. (proposed by H. B. Chamberlin).

Seventy-six presents were announced as having been received since the last meeting, including, amongst others,

J. Woodbridge Davis, The Dynamics of the Sun, presented by Mr. G. F. Chambers; Description of the Star Camera at the Sydney Observatory, and enlarged photograph of the region surrounding the η *Argûs* nebula, presented by Mr. H. C. Russell; Observations of Double Stars, part 2, and the orbit of *Iapetus*, by Asaph Hall, presented by the author; H. Jacoby, The Rutherfurd photographic measures of the group of the *Pleiades*, presented by the author; First and Second Reports of the Solar Physics Committee, presented by the Committee; Tables de Logarithmes à huit décimales, presented by the French War Office; S. Glasenapp, Mesures d'étoiles doubles, presented by the author; Two lantern slides of the region surrounding Nova *Aurigæ*, presented by the Lick Observatory; Photographs of double stars (lantern slide) to illustrate method of determining star magnitudes by photography, presented by Mr. W. E. Wilson; Photographs of the globular cluster 15 M *Pegasi*, and of the nebula H V 15, near 52 *Cygni*, presented by Mr. Roberts.

The Opposition of Mars, 1892. By E. J. Stone, M.A., F.R.S., Radcliffe Observer.

A circular has been recently issued from the Washington Observatory, in which a scheme is formulated for meridian observations of *Mars* from 1892, June 20, to September 23, for a redetermination of the constant of solar parallax.

The horizontal equatorial parallax of *Mars* at the opposition of 1892 reaches a limit of $23''.4$; but the planet has a considerable south declination, and this will somewhat reduce the combined parallactic displacements available from observations made at the northern and southern observatories, increase the probable errors of the observations, and render it more difficult to completely eliminate the effects of refraction errors by the observations of comparison stars than was the case in 1862 and 1877; but a result of considerable weight might probably be obtained if the co-operation of several southern and northern observatories could be secured, and the same comparison stars regularly observed at all the stations under the same instrumental conditions as the planet.

But the necessary co-operation has been rendered doubtful by the shortness of the notice given, which renders any modification of details difficult, and by the recommendation of a scheme of observation of a somewhat complicated character.

The method of determining the constant of solar parallax from meridian observations of *Mars* has always appeared to me one of the most powerful available for the purpose, and on the following grounds, viz.:—

1. The observations can be made by experienced observers, with instruments which they are accustomed to use, in the course of their regular duties, without the necessity of any change of methods of observation, and without any unusual strain or excitement.

2. Any outstanding errors of the refraction tables in use can be practically eliminated by the observation of comparison stars of greater and lesser zenith distance than the planet on each night at all the stations.

3. Any outstanding errors of division, or errors of flexure corrections, may be eliminated in mean results in a similar manner.

4. The observations can be made by so many different observers, with so many different instruments, that the effects of any ordinary systematic errors of meridian observations need not be feared.

5. The observations can be repeated at frequent intervals without any great disorganisation of the regular work of the meridian observatories.

6. The available parallactic displacements of *Mars* at favourable oppositions are so large, that an error of one per cent. in the adopted value of the constant of solar parallax will lead to discordances between theory and observation of more than a quarter of a second of arc, a quantity which much exceeds the ordinary accidental errors to be expected in the mean results derived from the observations which may be obtained at a single opposition.

7. The required constant of solar parallax is derived from a discussion of observations made under the same conditions, with the same instruments, and by the same observers, as those employed for the determination of the other constants which appear in the theoretical expressions in combination with the constant of solar parallax.

In the Washington Circular it is proposed to fix the position of the planet *Mars* by the method, introduced by Dr. Winnecke in 1862, of equal segments.

The adoption of this method requires that a system of parallel wires, movable by the declination-screw, should be placed in the eye-pieces at a distance apart somewhat less than the diameter of the planet at the opposition. This distance would in 1892 be about 16″. But no such wires are usually found in the eye-pieces of the transit-circles of meridian observatories; and the method of equal segments is not one with which meridian observers, in general, are familiar.

It is quite possible that observers who have had much experience with the method of equal segments might fix the position of the centre of *Mars* by this method with a slightly greater accuracy than by the more usual method of contacts; but it is at least very doubtful whether such will be the case with respect to observers who have had experience with the method of contacts, but not with that of equal segments; and

the introduction of the two wires to fix the position of the centre of the planet renders it absolutely necessary that the observations of the comparison stars should be equally distributed between the two wires on each night of observation, a condition which in practice cannot always be secured, from passing clouds.

But in the Washington Circular it is also proposed that a reflecting prism should be mounted outside the eye-piece, and that the observations of *Mars* and stars should be made half with, and half without, the use of the reflecting prism.

I fear that attempts to carry out this scheme will lead to greater systematic errors in fixing the relative differences in North Polar Distance between the centre of *Mars* and the comparison stars, from a want of symmetrical distribution of the observations of the stars between the two wires, than can be compensated for by any possible increase of accuracy from the use of the two wires and the reflecting prism.

The removal of the eye-piece for the insertion of a new pair of wires, the redetermination of the intervals and inclination of the wires, and the loss of observations which this will cause, must disorganise the work of an active meridian observatory to an extent which is hardly likely to be sanctioned, unless some very positive advantages are certain to be secured by the adoption of the system of parallel wires.

The results obtained in 1862 and 1877 did not indicate the existence of any systematic differences between the observations made with the pair of wires and the single wire when the observations of the comparison stars were properly distributed between the wires. I propose, therefore, to observe *Mars* and the comparison stars in the usual way with the single wire, and without the reflecting prism; and I hope that any directors of the southern observatories who may not be prepared to adopt the Washington scheme will yet observe the planet and comparison stars in the same way.

OBSERVING LIST FROM WASHINGTON CIRCULAR.

From June 20 to July 26.

Object.	Mag.	R.A.	δ
		h m s	° ′
O. Arg. S. 20970	7·0	20 50 38	−22 25·1
η Capricorni	5·0	20 58 15	20 16·8
27 Capricorni	6·5	21 3 23	20 59·2
ϕ Capricorni	5·5	21 9 30	21 5·9
Lacaille 8851	6·0	21 29 5	23 56·2
41 Capricorni	5·8	21 35 51	23 45·0
D.M.−20° 6923	7·5	21 41 42	20 4·3
Lalande 42700	7·2	21 49 37	21 38·8

From July 27 to August 10.

Object.	Mag.	R.A. h m s	δ ° ′
Lacaille 8463	6·2	20 23 11	−22 45·1
„ 8506	7·0	20 31 41	24 36·2
17 Capricorni	5·9	20 39 54	21 54·3
Lacaille 8612...	7·0	20 46 42	24 11·2
„ 8813...	6·0	21 19 36	24 17·2
„ 8832...	7·8	21 24 12	25 40·0
„ 8851...	6·0	21 29 5	23 56·2
O. Arg. S. 21562	7·8	21 35 24	22 25·3

From August 11 to September 23.

O. Arg. S. 20429	7·0	20 15 6	−23 49·1
Lacaille 8463	6·2	20 23 11	22 45·1
„ 8506	7·0	20 31 41	24 36·2
17 Capricorni	5·9	20 39 54	21 54·3
Lacaille 8734	7·0	21 7 1	25 17·2
Lalande 41404	7·5	21 14 32	22 50·7
ζ Capricorni	4·0	21 20 30	22 52·8
37 Capricorni	6·2	21 28 47	20 34·0

List of the Proper Motions in the Line of Sight of Fifty-one Stars.

By H. C. Vogel, Foreign Associate.

In continuation of my communication of 1891 December, on the spectrographic method (vol. lii. No. 2) I hereby transmit the definitive results of that investigation, the observations having been meanwhile brought to a close.

The complete discussion of these researches will be given in the *Publicationen des Astrophysikalischen Observatoriums*, Bd. VII. (Engelmann: Leipzig), which will probably appear during this month (June).

No.	Star.	Epoch.	No. of Plates.	Velocity relative to Sun. (English Miles) Vogel.	Scheiner.	Mean.
1	α Andromedæ	1889·93	2	+ 1·2	+ 4·4	+ 2·8
2	β Cassiopeiæ	1889·04	2	+ 0·8	+ 5·6	+ 3·2
3	α Cassiopeiæ	1890·14	2	− 9·3	− 9·7	− 9·5
4	γ Cassiopeiæ	1888·89	2	+ 2·5	− 6·9	− 2·2
5	β Andromedæ	1889·26	2	+ 5·6	+ 8·3	+ 7·0
6	α Ursæ minoris	1888·90	2	−15·8	−16·3	−16·1

No.	Star.	Epoch.	No. of Plates.	Velocity relative to Sun. (English Miles) Vogel.	Scheiner.	Mean.
7	γ Andromedæ	1889·34	2	− 4·9	−11·1	− 8·0
8	α Arietis	1889·69	3	− 9·0	− 9·3	− 9·2
9	β Persei †	1889·94	12	...	...	− 1·0
10	α Persei	1888·93	2	− 6·7	− 6·1	− 6·4
11	α Tauri	1889·16	4	+29·6	+30·7	+30·2
12	α Aurigæ	1888·98	11	+15·4	+15·0	+15·2
13	β Orionis	1889·24	14	+10·9	+ 9·5	+10·2
14	γ Orionis	1890·37	3	+ 8·0	+ 3·4	+ 5·7
15	β Tauri	1889·65	3	+ 5·6	+ 4·4	+ 5·0
16	δ Orionis	1890·07	4	− 0·1	+ 1·3	+ 0·6
17	ε Orionis	1889·00	3	+17·3	+15·6	+16·5
18	ζ Orionis	1889·00	2	+10·7	+ 7·8	+ 9·3
19	α Orionis	1889·32	2	+ 9·7	+11·7	+10·7
20	β Aurigæ †	1890·50	6	−16·0	−18·9	−17·5
21	γ Geminorum	1889·83	4	− 9·7	−10·8	−10·3
22	α Canis majoris	1890·09	10	− 8·4 ‡	−12·5	− 9·8
23	α Geminorum *	1889·16	3	−18·4 :	−18·4 :	−18·4 :
24	α Canis minoris	1889·68	3	− 4·9	− 6·5	− 5·7
25	β Geminorum	1889·06	2	+ 1·2	+ 0·2	+ 0·7
26	α Leonis	1889·22	2	− 5·3	− 6·1	− 5·7
27	γ Leonis	1889·76	2	−22·7	−25·2	−24·0
28	β Ursæ majoris	1889·39	2	−18·8	−17·6	−18·2
29	α Ursæ majoris	1889·11	4	− 6·4	− 7·9	− 7·2
30	δ Leonis	1889·94	3	− 9·3	− 8·6	− 8·9
31	β Leonis	1889·59	3	− 8·6	− 6·5	− 7·6
32	γ Ursæ majoris	1889·40	2	−18·6	−14·4	−16·5
33	ε Ursæ majoris	1889·39	2	−21·3	−16·2	−18·8
34	α Virginis †	1890·34	27	...	...	− 9·2
35	ζ Ursæ majoris * †	1890·33	8	−20·2	−18·5	−19·4
36	η Ursæ majoris	1889·83	2	−17·8	−14·8	−16·3
37	α Bootis	1889·57	6	− 4·4	− 5·2	− 4·8
38	ε Bootis	1889·36	2	−10·4	− 9·7	−10·1
39	β Ursæ minoris	1889·24	4	+ 8·9	+ 8·8	+ 8·9
40	β Libræ	1889·34	1	− 6·0 :		− 6·0 :
41	α Coronæ Borealis	1890·91	5	+19·7	+20·0	+19·9
42	α Serpentis	1889·36	1	+14 ::		+14 ::

* Brightest component. † Motion of the system. ‡ Weight 2.

No.	Star.	Epoch.	No. of Plates.	Velocity relative to Sun. (English Miles) Vogel.	Scheiner.	Mean.
43	β Herculis	1889·46	2	−21·3	−22·6	−22·0
44	α Ophiuchi	1889·09	2	+12 9	+10 9	+11 9
45	α Lyræ	1889·64	8	− 8·7	−10·2	− 9·5
46	α Aquilæ	1888·81	3	−24·7	−21·1	−22·9
47	γ Cygni	1888 93	2	− 3·6	− 4·3	− 4·0
48	α Cygni	1888·99	4	− 3·7	− 6·2	− 5·0
49	ε Pegasi	1888·81	2	+ 4·6	+ 5·4	+ 5·0
50	β Pegasi	1889·90	1	+ 4·1 :		+ 4·1 :
51	α Pegasi	1888·81	2	+ 1·1	+ 0·4	+ 0·8

Greatest observed velocity ... +30·2 miles (α Tauri); −24·0 miles (γ Leonis)

Average velocity ... ... 10·4 miles.

No. of stars with positive velocity greater than 10·4 miles 7

No. of stars with negative velocity greater than 10·4 miles 11

Average probable error of the measurements for a single plate and one observer ... ... ± 1·6 mile

: denotes less certain, and :: uncertain.

Potsdam, Royal Observatory:
1892 *June.*

Photographs of the Region of the Globular Cluster 15 *M Pegasi.*

By Isaac Roberts, F.R.S.

Three photographs of the region of 15 M *Pegasi*, R.A. $21^h\ 25^m$, declination 11° 41′ N., have been taken with the 20-inch reflector, the first on 1890 November 4, with an exposure of two hours, the second on 1891 October 4, with an exposure of thirty minutes, and the third on 1891 November 27, with an exposure of sixty minutes.

The enlarged photographs now presented have been made from the first of the negatives with the exposure of two hours, and the scales of the enlargements are one millimetre to four seconds of arc in one, and one millimetre to twenty-four seconds in the other.

Sir John Herschel in his observations of nebulæ and clusters of stars, No. 2120, writes of M 15 as "a magnificent globular cluster; comes up to a perfect blaze in the centre, like a protuberance or nipple, not the condensation of a homogeneous globe; it has straggling streams of stars, as it were, drawing to

a centre, is irregularly round, very faint stars 15 magnitude all distinct, but running together into a blaze in the middle, 4′ or 5′ diameter."

Lord Rosse records four observations of the cluster between the years 1852 and 1876, and he states that the stars are bright and faint, and sharply distinct from each other; nucleus a little excentric from the middle. These descriptions convey but little information that is of scientific value, and there are no drawings for comparison with the photographs.

A well-executed print from an enlargement of a photograph of this cluster is given in the volume of the *Specola Vaticana* for 1891, and I have compared it with these photographs, and give the following results:—The stars are easily identified on the respective photographs, but the extent of the nebulosity differs largely. On the Vatican print it can be measured to about sixty-five seconds of arc in diameter round the nucleus, but on my print it measures about 200 seconds of arc. The Vatican print does not cover the whole of the cluster, and in that respect these prints convey a fuller idea of the magnificent proportions of the object. Several rings of stars are visible round the margin of the cluster, and there are also branches, extending in various directions.

Now that we have accurate records of the position and magnitude of every star in the cluster, it is obvious that a few years hence it will be possible to unravel the mysteries that present themselves to us in this and in several other similar star clusters.

Photograph of the Nebula ♅ *V* 15, *near* 52 *Cygni.*

By Isaac Roberts, F.R.S.

The enlarged photograph now presented was made from a negative, taken with the 20-inch reflector, on 1891 September 28, and exposure of the plate during four hours of clear sky, and represents the region round the double star, 52 *Cygni*, R.A. $20^h\ 41^m$, declination 30° 20′ N., on the following side of which is the remarkable nebula ♅ V 15.

This nebula is thus described by Sir John Herschel in his observations of nebulæ and clusters of stars, No. 2088. The nebula is very long and winding, and runs northward from k (52), full two fields breadth (30′). The nebula extends southwards far beyond k *Cygni*, but is extremely faint; the northern part is pretty bright, and extends to two stars. Northwards from k *Cygni*, 27′, extends a curved tail of nebula of a serpentine form, fading very gradually into two tails forming a fork.* A drawing of the nebula is given in the *Phil. Trans.* R.S., in 1833

* Abridged description.

November, which shows very fairly in its outline parts of the brighter nebulosity, but the photograph clearly shows that these form part of an irregular oval nebula of gigantic dimensions. It is more than two degrees in length from north to south, and forty-seven minutes of arc in breadth on the following side of 52 *Cygni*, which it barely touches by a slight projection. The nebulosity is of a very faint streaky character, excepting that which was seen by Sir John Herschel. The nebula as a whole is not symmetrical, but seems to be made up of detached patches of light covering the large area, and a much longer exposure than four hours will be required to show the connections of these diffused patches of light. It will be observed on examination of the photograph that the stars on the *following* side of 52 *Cygni* are very much more numerous than they are on the *preceding* side. The bright part of the nebula seems to form almost a defined boundary between the stream of the Milky Way stars and those on its *preceding* side. The straight line across 52 *Cygni* was caused by a sudden gust of wind during the exposure of the plate.

Photograph of η Argûs. By H. C. Russell.

I think the photograph sent herewith, which is an enlargement of one of our photographs of *η Argûs*, taken with the star camera and $5\frac{3}{4}$ hours' exposure, will be interesting to the members of our Society. The scale is 12·4 inches = 1°; and it brings out in a satisfactory way most, but not all, that the negative contains. The scale is five-sixths of that adopted by Herschel in the Cape observations, and a comparison of the two is very suggestive. In the denser parts I have counted over 100 stars in a square inch, or more than 3500 stars in a degree, and in some places they run up to 130 in a square inch, upwards of 4500 in a degree, and the enlargement has lost many of the fainter stars visible on the negative. The mottled appearance of the nebula and its vast extent are strikingly brought out. The scale in the original negative is not large enough to divide some of the close groups, hence they appear in the enlargement as one star.

Sydney Observatory:
1892 *April* 11.

Orbit of 9 *Argûs*, β 101. By Professor S. Glasenapp.

(*Letter from Professor S. Glasenapp to S. W. Burnham.*)

The complete measures of 9 *Argûs*, which I have had the honour to receive from you, have enabled me to investigate the orbit of this interesting binary star. I find for this system a period of 40·54 years. The eccentricity is extraordinarily small, being only 0·09.

The following table contains the measures of 9 *Argûs*, made by Dembowski (Δ), the Astronomers at the Cincinnati Observatory (Cin.), Burnham (β), Hall (Hl.) and Schiaparelli (Sp.)

1875·71	289°·4	0″·46	Δ	3*n*
1878·47	302·6	0·45	Cin	4*n*
1878·52	301·8	0·46	β	1*n*
1879·68	306·2	0·38	Hl	2*n*
1882·21	319·7	0·35	Sp	4*n*
1883·11	336·2	0·3	β	1*n*
1889·08	76·4	0·34	β	4*n*
1890·19	83·0	0·4	Sp	2*n*
1890·26	84·6	0·31	β	4*n*
1890·96	88·3	0·36	β	3*n*
1891·15	94·7	0·3	Sp	1*n*
1892·05	98·7	0·22	β	3*n*

From these observations we form the annual means for 1878, 1890, and 1891, assigning to the two measures of distance made by Professor Schiaparelli in 1890 and 1891 a weight equal to one-half, and thus obtain the following normal places:—

1875·71	289°·4	0″·46	1888·26	356°·1	0″·29
78·50	302·2	0·45	89·08	76·4	0·34
79·68	306·2	0·38	90·22	83·8	0·34
82·21	319·7	0·35	91·06	91·5	0·34
83·11	336·2	0·30	92·05	98·7	0·22

By the graphical method we obtain the geometrical elements of the true orbit as follows:—

$\Omega_0 = 116°·6$ $\quad e_0 = 0·105$

$i_0 = 55·8$ $\quad a_0 = 0″·48$

$\lambda_0 = 252·3$

And then the dynamical elements from the first and last observations :—

$$T_0 = 1843{\cdot}02$$
$$n_0 = +8^\circ{\cdot}774$$
$$u_0 = 41{\cdot}03 \text{ years.}$$

We obtain the following corrections to the elements by the method of least squares :—

$$\Delta T = +1{\cdot}00 \text{ years}; \ \Delta n = +0^\circ{\cdot}106; \ \Delta \Omega = +0{\cdot}1;$$
$$\Delta i = +3^\circ{\cdot}4; \ \Delta \lambda = -1^\circ{\cdot}0; \ \Delta e = -0{\cdot}015; \ \Delta a = -0''{\cdot}03.$$

So that the most probable elements of the true orbit of 9 *Argûs* will be :—

$T = 1844{\cdot}02$	$i = 59^\circ{\cdot}2$
$u = 40{\cdot}54$ years	$\lambda = 251^\circ{\cdot}3$
$n = +8^\circ{\cdot}880$	$e = 0{\cdot}090$
$\Omega = 116^\circ{\cdot}7$	$a = 0''{\cdot}45$

The comparison of these elements with the observations is given in the following table :—

T	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
1875·71	289°·4	287°·5	+1°·9	0″·46	0″·43	+0″·03
78·50	302·2	301·1	+1·1	0·45	0·42	+0·03
79·68	306·2	307·4	−1·2	0·38	0·40	−0·02
82·21	319·7	324·9	−5·2	0·35	0·32	+0·03
83·11	336·2	333·7	+2·5	0·30	0·29	+0·01
89·08	76·4	73·6	+2·8	0·34	0·27	+0·07
90·22	83·8	85·4	−1·6	0·34	0·32	+0·02
91·06	91·5	92·1	−0·6	0·34	0·35	−0·01
92·05	98·7	98·7	0·0	0·22	0·38	−0·16

The position of this star for 1880 is :—

$$\left.\begin{aligned} \alpha &= 7^h\ 46^m\ 13^s \\ \delta &= -13^\circ\ 35' \end{aligned}\right\}$$

The system has an annual proper motion of 0″·345 in the direction of 195°·7. It should receive the attention of astronomers with large telescopes.

Observatoire de l'Université Impériale, St.-Pétersbourg :
1892 *April* 24.

Orbit of the Double Star κ Pegasi A C.

By Professor S. Glasenapp.

(*Communicated by S. W. Burnham.*)

In 1880 Mr. S. W. Burnham, M.A., discovered the duplicity of the large star of the binary κ *Pegasi* ($\alpha = 21^h\ 39^m{\cdot}7$, $\delta = +25°\ 8'$ for 1890). The new companion (C) has been observed only by Mr. Burnham and by the late R. Engelmann; no other observations have been published. The following observations have been kindly communicated to me by Mr. S. W. Burnham :—

T	θ	ρ	Observer.
1880·68	137°·9	0″·27	β 4*n*
83·02	116·0	0·16	En 1*n*
84·01	140·0	0·25	En 1*n*
84·87	104·7	0·22	β 1*n*
88·78	274·7	0·23	β 3*n*
89·51	262·3	0·14	β 4*n*
90·57	187·1	0·10	β 4*n*
91·61	150·0	0·10	β 3*n*
91·81	144·6	0·13	β 4*n*
92·36	135·1	0·17	β 1*n*

For the investigation of the orbit we take a simple mean of the three observations, made in 1883 and 1884 by Engelmann and Burnham; in this manner we obtain for 1883·97 a mean position $\theta = 120°\ 2$ and $\rho = 0''{\cdot}21$. It would be better perhaps to reject the observation of Engelmann made in 1884, but as the value of the measures can be estimated only after the investigation of the orbit, we retain it.

The following table, therefore, embraces all the measured positions :—

T	θ	ρ	T	θ	ρ
1880·68	137°·9	0″·27	1890·57	187°·1	0″·10
83·97	120·2	0·21	91 61	150·0	0·10
88 78	274·7	0·23	91·81	144·6	0 13
89·51	262·3	0·14	92·36	135·1	0·17

It is evident that the satellite has described a whole revolution; the elements of the orbit can therefore be determined with satisfactory precision. By the graphical method we very easily obtain the following system of elements :—

T = 1898·8	λ = 199·9
U = 11·54 years ($n = -31°·196$)	e = 0·28 ($\phi = 16°·26$)
☊ = 133°·0	a = 0″·21
i = 71°·6	

and then the corrections of ☊, i and ϕ, namely: $d\Omega = -7°·34$, $di = -5°·62$, and $d\phi = -4°·723$, so that the most probable system of elements will be

T = 1898·8	λ = 199·90
U = 11·54 years ($n = -31°·196$)	e = 0·20 ($\phi = 11°·537$)
☊ = 125°·66	a = 0″·21
i = 65°·98	

The comparison of these elements with the observations is given in the following table:—

T	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
1880·68	137°·9	142°·8	− 4°·9	0″·27	0″·21	+0″·06
83·97	120·2	109·0	+11·2	0·21	0·19	+0·02
88·78	274·7	281·8	− 7·1	0·23	0·14	+0·09
89·51	262·3	252·1	+10·2	0·14	0·10	+0·04
90·57	187·1	184·2	+ 2·9	0·10	0·13	−0·03
91·61	150·0	152·1	− 2·1	0·10	0·17	−0·07
91·81	144·6	148·7	− 4·1	0·13	0·18	−0·05
92·36	135·1	141·1	− 6·0	0·17	0·21	−0·04

The element λ (distance between the node and the periastron) could not be determined with great exactitude, because there are only two observations of the satellite in 1888 and 1889 from which it can be determined.

In the differences between the calculated and observed distances we remark a singular relation; all the distances measured before 1890 are larger than the calculated, and all the distances measured after 1890 are smaller. This might be supposed to indicate defective elements of the orbit, but it may be explained by the fact that the earlier observations were made with smaller telescopes than the later ones, for distances are always measured too great with small telescopes.

The star is very close, and can be observed only with large telescopes; it belongs to the class of binaries of very short period, its period being one of only 11·5 years.

1892 *June* 4.

The Orbit of OΣ 269. By J. E. Gore.

A measure made by Mr. Burnham last year, of this close and difficult double star, discovered by O. Struve in 1844, shows that one revolution had then been nearly completed. I have computed the orbit and find the following provisional elements :—

Elements of OΣ 269.

P = 47·70 years.	Ω = 51° 56′
T = 1883·12	λ = 43° 30′·5
e = 0·0575	μ = + 7°·547
i = 82° 48′·7	a = 0″·58

These elements are remarkable for the high inclination and small eccentricity of the real orbit, an eccentricity very unusual in binary stars. The apparent ellipse I find very much resembles that given by Mr. Burnham in the *Observatory* for 1891 July, but is more elongated.

The following is a comparison between the above elements and the measures used in computing the orbit :—

Epoch.	Observer.	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_o$
		°	°	°	″	″	″
1844·31	O. Struve	218·0	218·0	0·0	0·33	0·26	+0·07
1846·39	,,	223·8	224·2	−0·4	0·39	0·39	0·0
1851·39	,,	228·9	230 6	−1·7	0·33	0·59	−0·26
1861·26	,,	242·8	242·8	0·0	0·33	0·34	−0·01
1883·41	Engelmann	61·4	60·1	+1·3	0·22	0·36	−0·14
1891·26	Burnham	213·4	213·4	0·0	0·22	0·21	+0·01

On the assumption that the mass of the system is equal to the mass of the Sun, the "hypothetical parallax" would be

$$p = \frac{a}{P^{\frac{2}{3}}} = 0''{\cdot}044$$

According to the Draper Catalogue of Stellar Spectra the spectrum of the star is of the first type (A).

According to Burnham the magnitudes of the components are 7·2 and 7·7. The star is *Lalande* 25074, and its position for 1900 is

R.A. $13^h\ 28^m{\cdot}3$

Decl. + 35° 25′

On the Formulæ of Reduction to Apparent Places of Close Polar Stars. By F. Folie.

(*Communicated by A. M. W. Downing.*)

In the *Bulletin Astronomique* (February 1888 and seq.) I made some criticisms upon the method proposed by Fabritius for the reduction of close polar stars, and on his demonstration of it, and I exhibited the discordance between the form adopted and the formulæ used in the *Berliner Jahrbuch*, the latter being more correct.

M. Fabritius, in tom. iii. of the *Observations of Kiew*, having again contested my criticisms, and given a new demonstration of his formulæ, I have made a new inquiry on the terms of second order, by a process giving the same form as his own, but with some additional terms.

The importance of the question, and the recent investigation of Mr. Downing on the computation of apparent places for *Polaris* (*Monthly Notices*, lii. 5, p. 378), give me hope that the present lines will be read with interest by astronomers.

The investigation of the terms of the second order is threefold:—

1. Terms of the second order of the nutation.
2. Terms of the second order due to the combination of the nutation and aberration.
3. Terms of the second order of the aberration.

1. *Terms of the Second Order of the Nutation.*

The first of these investigations is the most complicated, and the method I have adopted is a new one. I here give a summary of it.

The equations:—

$$(1)\qquad \begin{aligned} \frac{d\alpha}{dt} &= (\cot\epsilon + \sin\alpha\tan\delta)\frac{d\mu}{dt} - \cos\alpha\tan\delta\frac{d\theta}{dt} \\ \frac{d\delta}{dt} &= \cos\alpha\frac{d\mu}{dt} + \sin\alpha\frac{d\theta}{dt}; \end{aligned}$$

where

$$d\mu = \sin\epsilon\, d\lambda,$$

and, if α, δ are the mean values of the co-ordinates for the beginning of the year, give the terms of first order:—

$$(2)\qquad \begin{aligned} \Delta_1\alpha &= (\cot\epsilon + \sin\alpha\tan\delta)\,\Delta\mu - \cos\alpha\tan\delta\Delta\theta \\ \Delta_1\delta &= \cos\alpha\Delta\mu + \sin\alpha\Delta\theta. \end{aligned}$$

To these terms we must add $\delta\Delta_1\alpha$, $\delta\Delta_1\delta$, because in the equation (1) are included the true co-ordinates; so that α, δ are the mean co-ordinates, and $\alpha+\Delta_1\alpha$, $\delta+\Delta_1\delta$ the true ones.

From (1), if ϵ is considered constant, we have

$$\frac{d\delta\Delta_1\alpha}{dt} = \tan\delta\Delta_1\alpha\left(\cos\alpha\frac{d\mu}{dt}+\sin\alpha\frac{d\theta}{dt}\right)+\sin^2\delta\Delta_1\delta\left(\sin\alpha\frac{d\mu}{dt}-\cos\alpha\frac{d\theta}{dt}\right)$$

$$(3)\qquad = \tan\delta\Delta_1\alpha\frac{d\delta}{dt}+\frac{1}{\sin\delta\cos\delta}\Delta_1\delta\left(\frac{d\alpha}{dt}-\cot\epsilon\frac{d\mu}{dt}\right)$$

$$= \tan\delta\frac{\Delta_1\alpha d\delta+\Delta_1\delta d\alpha}{dt}+\cot\delta\Delta_1\delta\frac{d\alpha}{dt}-\frac{2}{\sin 2\delta}\cot\epsilon\Delta_1\delta\frac{du}{dt},$$

and

$$\frac{d\delta\Delta_1\delta}{dt} = -\Delta_1\alpha\left(\sin\alpha\frac{d\mu}{dt}-\cos\alpha\frac{d\theta}{dt}\right) = -\cot\delta\Delta_1\alpha\left(\frac{d\alpha}{dt}-\cot\epsilon\frac{d\mu}{dt}\right).$$

Integrating and neglecting the terms in which $\tan\delta$ and $\sec\delta$ are not included:

$$\delta\Delta_1\alpha = \tan\delta\Delta_1\alpha\Delta_1\delta-\frac{2}{\sin 2\delta}\cot\epsilon\int\Delta_1\delta\frac{d\mu}{dt}$$

$$(4)\qquad = \tan\delta\Delta_1\alpha\Delta_1\delta-\frac{2\cot\epsilon}{\sin 2\delta}\left(\tfrac{1}{2}\cos\alpha\,(\Delta\mu)^2+\sin\alpha\int\Delta\theta d\mu\right).$$

$$\delta\Delta_1\delta = -\tfrac{1}{2}\cot\delta(\Delta_1\alpha)^2.*$$

If

$$F = -\frac{2\cot\epsilon}{\sin 2\delta}\left(\tfrac{1}{2}\cos\alpha(\Delta\mu)^2+\sin\alpha\int\Delta\theta d\mu\right),$$ the equation (4) becomes

$$(4')\qquad \delta\Delta_1\alpha = \tan\delta\Delta_1\alpha\Delta_1\delta+F$$

$$\delta\Delta_1\delta = -\tfrac{1}{2}\cot\delta(\Delta_1\alpha)^2,$$

forms of Fabritius with the term F in addition.

2. *Combination of the Nutation and the Annual Aberration.*

The terms of the second order arising from the combination of the nutation and the aberration are in the very convenient forms given by Wagner †; if $\Delta_1\alpha$, $\Delta_1\delta$ are the terms of first order of the nutation, and A_α, A_δ those of the aberration,

$$(5)\qquad \delta A_\alpha = \tan\delta A_\alpha\Delta_1\delta+\frac{2}{\sin 2\delta}A_\delta\Delta_1\alpha;$$

$$\delta A_\delta = -\tfrac{1}{2}\sin 2\delta A_\alpha\Delta_1\alpha.$$

3. *Terms of the Second Order of the Aberration.*

The terms of the second order of the annual aberration may be put in a similar form if we omit the terms in which $\tan^2\delta$ in right

* If this form gives $\delta\Delta_1\delta$ infinite for $\delta=0$, as M. Fabritius thinks (*Obs. de Kiew*, t. iii.), it is only in appearance; $(\Delta_1\alpha)^2$ is, in reality, $\Delta_1\alpha\int\left(\frac{d\alpha}{dt}-\cot\epsilon\frac{d\mu}{dt}\right)dt$, and this is of the form $\tan\delta\int f(t)dt$; so that $\cot\delta$ disappears.

† *Obs. de Poulkova*, t. i. See also my *Traité des Réductions Stellaires*, p. 79.

ascension, tan δ or sec δ in declination, are not included, so that :—

$$(6) \qquad \Delta A_\alpha = \frac{2}{\sin 2\delta} A_\alpha A_\delta$$

$$\Delta A_\delta = -\tfrac{1}{4} \sin 2\delta A_\alpha^2 - \frac{2}{\sin 2\delta} (A_\delta)^2.$$

4. *Some of the Terms of Second Order of the Nutation and of the Annual Aberration.*

Combining now all the terms of the second order given above, Δ_α, Δ_δ being the terms of the first order of the complete reduction to the apparent place, and $\Delta^2\alpha$, $\Delta^2\delta$ those of the second order, we have, first,

$$\Delta_\alpha = \Delta_1\alpha + A_\alpha$$
$$\Delta\delta = \Delta_1\delta + A_\delta.$$

Taking the sum of the formulæ (4′) (5) and (6) we obtain in right ascension

$$\Delta^2\alpha = \tan\delta \Delta_1\delta(\Delta_1\alpha + A_\alpha) + \frac{2}{\sin 2\delta} A_\delta(\Delta_1\alpha - A_\alpha) + F.$$

But

$$\frac{2}{\sin 2\delta} = \frac{\tan\delta}{\sin^2\delta}, \text{ and, for polar stars, } = \tan\delta + \tfrac{1}{3}\sin 2\delta,$$

and sin 2δ being very small, we may neglect $\frac{1}{2}$ sin 2δ, hence

$$\Delta^2\alpha = \tan\delta \Delta\alpha \Delta\delta + F$$
$$(7) \qquad \Delta^2\delta = -\tfrac{1}{2}\cot\delta(\Delta_1\alpha)^2 - \tfrac{1}{2}\sin 2\delta A_\alpha \Delta_1\alpha - \tfrac{1}{4}\sin 2\delta A_\alpha^2 - \frac{2}{\sin 2\delta}(A_\delta)^2;$$

also, putting

$$\tfrac{1}{2}\sin 2\delta = \cot\delta$$
$$\Delta^2\delta = -\tfrac{1}{2}\cot\delta(\Delta_1\alpha + A_\alpha)^2 - \tan\delta(A_\delta)^2$$
$$(7') \qquad = -\tfrac{1}{2}\cot\delta(\Delta\alpha)^2 - \frac{2}{\sin 2\delta}(A_\delta)^2,$$

this being the first form of Fabritius* with the additional term

$$-\frac{2}{\sin 2\delta}(A_\delta)^2.$$

If, on the contrary, we put $\frac{1}{4}$ sin 2δ instead of $\frac{1}{2}$ cot δ, we have

$$(7'') \qquad \Delta^2\delta = -\tfrac{1}{4}\sin 2\delta(\Delta\alpha)^2 - \frac{2}{\sin 2\delta}(A_\delta)^2,$$

this differing only by the last term from the second form given

* *Obs. de Kiew*, t. i., and Oppolzer, *Traité de la Détermination des Orbites*, p. 264.

by Fabritius in consequence of our criticism.* We give the preference to this last form for two reasons: first, the calculation of sin 2δ is used in the two terms; second, sin 2δ is factor in two terms in (7), and cot δ only in one. Therefore we adopt for the terms of the second order of the reduction to the apparent place

$$\Delta^2\alpha = \tan\delta\Delta\alpha\Delta\delta + \mathrm{F}$$

$$\Delta^2\delta = -\tfrac{1}{4}\sin 2\delta(\Delta\alpha)^2 - \frac{2}{\sin 2\delta}(\mathrm{A}_\delta)^2,$$

differing from those of Fabritius by the last terms, which should not be neglected.

If we make use, for the reduction of close polar stars, of the very convenient forms of Fabritius, we are then obliged to add: in A R,

$$\mathrm{F} = -\cot.\epsilon\tan\delta\{\tfrac{1}{2}\cos\alpha(\Delta\mu)^2 + \sin\alpha\int\Delta\theta d\mu\}$$

$$= -\tan\delta\{\cos\alpha[0''.0023t^2 - 0''.0015\sin\Omega t] - 0.0063\sin\alpha\sin\Omega\};$$

and in δ:

$$-\frac{2}{\sin 2\delta}(\mathrm{A}_\delta)^2.$$

5. *Periodic terms of the systematic aberration.*

I have called attention to these terms in my *Traité des Réductions Stellaires* (1888). I will find these terms in right ascension and in declination, not taking account of other terms of the second order, included in the preceding formulæ, with the exception of very small terms (of the second order) depending on the longitude of the Sun and of the perigee.

The formulæ of the aberration are:

$$\mathrm{K}\cos\delta'\cos\alpha' = \cos\delta\cos\alpha + \frac{1}{v}\mathrm{V}_x \tag{1}$$

$$\mathrm{K}\cos\delta'\sin\alpha' = \cos\delta\sin\alpha + \frac{1}{v}\mathrm{V}_y \tag{2}$$

$$\mathrm{K}\sin\delta' = \sin\delta + \frac{1}{v}\mathrm{V}_x; \tag{3}$$

from which we take

$$\Delta\alpha = \frac{\sec\delta}{v}(\cos\alpha\mathrm{V}_y - \sin\alpha\mathrm{V}_x) - \frac{\sec^2\delta}{v^2}(\cos\alpha\mathrm{V}_y - \sin\alpha\mathrm{V}_x)(\sin\alpha\mathrm{V}_y + \cos\alpha\mathrm{V}_x). \tag{4}$$

From (1) and (2) we may deduce

$$\mathrm{K}\cos\delta' = \cos\delta + \frac{\cos\delta}{v}(\sin\alpha\mathrm{V}_y + \cos\alpha\mathrm{V}_x) + \tfrac{1}{2}\frac{\sec\delta}{v^2}(\mathrm{V}_x{}^2 + \mathrm{V}_y{}^2), \tag{5}$$

* *Obs. de Kiew*, t. iii.

and from (3) and (5)

$$\Delta\delta = \frac{\cos\delta}{v}\left\{ V_z - \sin\delta(\sin\alpha V_y + \cos\alpha V_x \right\} - \tfrac{1}{2}\frac{\tan\delta}{v^2}(V_x^2 + V_y^2),$$

if we make abstraction of the terms of second order, in which $\tan\delta$ is not included.

If we take only into account the annual and the systematic aberration, calling m_1 the mean motion of the Sun, σ_1 the systematic velocity, σ' its projection on the equator, A′, D′ the coordinates of the apex, s, c the sin and cos of the obliquity, $\odot$ the Sun's longitude, we have:

$$V_x = m_1 \sin\odot + \sigma' \cos A'$$
$$V_y = -m_1 c \cos\odot + \sigma' \sin A'$$
$$V_z = -m_1 s \cos\odot + \sigma' \tan D';$$

and therefore

$$(6)\quad \cos\alpha V_y - \sin\alpha V_x = -m_1(c\cos\alpha\cos\odot + \sin\alpha\sin\odot) + \sigma'\sin(A'-\alpha)$$

$$(7)\quad \sin\alpha V_y + \cos\alpha V_x = -m_1(c\sin\alpha\cos\odot - \cos\alpha\sin\odot) + \sigma'\cos(A'-\alpha)$$

$$V_x^2 + V_y^2 = m_1^2(\sin^2\odot + c^2\cos^2\odot) + \sigma'^2 - 2m_1\sigma'(c\sin A'\cos\odot - \cos A'\sin\odot);$$

or, neglecting the constant terms,

$$V_x^2 + V_y^2 = -\tfrac{1}{2}m_1^2 s^2\cos 2\odot - 2m_1\sigma'(c\sin A'\cos\odot - \cos A'\sin\odot).$$

Taking only into account in the formulæ (6) and (7) the periodical terms of the systematic aberration:

$$(\cos\alpha V_y - \sin\alpha V_x)(\sin\alpha V_y + \cos\alpha V_x)$$
$$= -m_1\sigma'\{c\cos(A'-2\alpha)\cos\odot - \sin(A'-2\alpha)\sin\odot\}.$$

The periodical terms of the systematic aberration will be therefore, if a be the annual constant of aberration, and a' the reduced constant of systematic aberration, viz., projected on the equator:

$$\Delta^2\alpha = -a\alpha'\sec^2\delta\{c\cos(A'-2\alpha)\cos\odot - \sin(A'-2\alpha)\sin\odot\}$$
$$\Delta^2\delta = aa'\tan\delta(c\sin A'\cos\odot - \cos A'\sin\odot).$$

If $a^1 = a$, aa^1 (expressed in seconds of arc) $= 0''{\cdot}002$, the terms above may not be neglected, in the reduction of close polar stars.

These formulæ offer a very easy means of computing a', a means unknown until to-day.

When the constant of the systematic aberration is known, we may compute the terms arising from the combination of this aberration with the nutation. These are (making abstraction of the terms of first order, A'_α and A'_δ,

which are not periodical and cannot be used in the formulæ of reduction):

$$\delta A'_{\alpha} = \tan \delta A^1{}_{\alpha} \Delta_1 \delta - \frac{2}{\sin 2\delta} A'_{\delta} \Delta_1 \alpha$$

$$\delta A'_{\delta} = \tfrac{1}{2} \sin 2\delta A^1{}_{\alpha} \Delta_1 \alpha.$$

If the systematic velocity be of the same order as the velocity of the Earth, these terms will be of the same magnitude as the corresponding terms in the annual aberration.

Uccle: May 5.

On a Parallel-Plate Double-Image Micrometer. By J. H. Poynting.

(*Communicated by Sir R. S. Ball.*)

If a ray of light passes through a plate of glass with parallel faces it emerges parallel to its original direction, but with any other than normal incidence it is shifted through a distance proportional nearly to the tangent of the angle of incidence, up to quite considerable values of that angle.

I have already published an account of a use of this property in obtaining a fine adjustment for a cathetometer telescope. (*Phil. Trans.* vol. 182 (1891), A., p. 588.) A parallel plate movable round a horizontal axis is placed just in front of the object-glass. The telescope is brought nearly to the level of the point to be sighted, and the final adjustment is completed by tilting the plate until the point appears on the cross wire.

We have for some time used a similar device with a microscope on the Mason College Physical Laboratory for the measurement of small objects, placing the parallel plate between the stage and objective. It is very easy and very rapid in use. The plate might be placed, for the measurement of smaller objects, between the objective and eyepiece, but we have never required the sensitiveness which would thus be obtained.

I have lately applied the principle in the construction of a double-image micrometer for a telescope, and as the instrument, as far as I can test it, appears to be successful, it may be worthy of description.

A circular parallel plate of glass, rather more than 1 inch in diameter and about $\frac{1}{8}$ inch thick, being cut down the middle, one half is fixed in one semicircle of a ring, while the other is placed in the other semicircle, attached, however, to an axis passing through a bearing in the ring, so that the plate can be rotated, the axis being in the plane of the fixed plate and perpendicular to its edge at the middle point. The ring is

fixed in the tube of a 4-inch telescope of about 67 inches focal length, 16 inches in front of the focal plane, the division between the two plates being vertical. The axis of the movable plate passes out horizontally through the side of the tube, and a pointer is attached at right angles to it moving over a fixed straight scale, the pointer being nearly at the middle of the scale when the two plates are in one plane.

On looking at a star with the plates thus in one plane one image only is seen. But on moving the pointer the one plate is tilted and all the rays through it are shifted, so that two images appear, their separation being proportional nearly to the movement of the pointer along the scale. In the fixed position of the micrometer with the division between the plates vertical, it is possible only to measure vertical distances. For general use, of course, it should be possible to revolve it about the axis of the telescope. It was fixed merely for simplicity of construction in preparing it to test the method.

The separation of the images for a given angle of tilt might be calculated by the method given at the end of this note, knowing the exact thickness of the plate and its refractive index. But it appeared preferable to obtain the value per division of the scale by experiment. For this purpose the eyepiece of the telescope was removed and a fine scale of 500 divisions to the inch was fixed in the focal plane of the objective. Another telescope focussed for an infinite distance was then placed in front of the objective and the image of the fine scale was viewed by it. The movable plate was then tilted so that the lines of the fine scale in one image moved one place on, two places on, and so on, the positions of coincidence being easily determined. The tilts corresponded, of course, to displacements of the image, in the use of the micrometer, by successive 1-500ths of an inch. Within more than ten divisions on each side of the middle of the pointer scale the movements were proportional to the shifting of the fine scale, and the mean of a number of readings made twenty-one divisions of the pointer scale correspond exactly to eight divisions of the fine scale. The effective focal length of the objective might be taken as 67·16 inches, this being the distance from the near side of the flint glass to the focal plane. For exact work it would be necessary to calculate the position of the principal point for the system of lenses, but this would be quite needless refinement here. Hence

$$1 \text{ division of pointer scale} = \frac{8}{21} \times \frac{1}{500} \times \frac{1}{67{\cdot}16} \text{ radius, or } 2{\cdot}34 \text{ seconds.}$$

As ten divisions of the pointer scale occupy a length of 12·68 mm., and the scale is 67·5 mm. from the axis, ten divisions means an angle of tilt less than 11°, and up to this the error in taking the displacement as proportional to the movement of the pointer along the scale is not more than 1 in 600. I have found that with my telescope it is quite sufficient to move the pointer

by hand, though with a steady stand and good definition a screw motion would be useful.

I have tested the micrometer by measuring the distance between the components of *Castor* when one is vertically over the other, and by measuring a vertical diameter of *Saturn*, using a power of 100. I have no experience of micrometer work, and do not know the accuracy to be expected, but, considering the very inferior definition of my telescope, and the unsteadiness of the stand, the results obtained appear to be hopeful for the success of the method.

The following are the results, in each case, of course, giving double the actual angle.

DISTANCE BETWEEN TWO COMPONENTS OF CASTOR.

1892 *April* 22. *Readings of Pointer Scale.*

1st position with one component in one image on the other component in the other image.	2nd position with one component in one image on the other component in the other image.
34·2	28·6
33·1	28·1
33·1	28·1
33·1	27·7
32·9	28·5

Rejecting the first readings as made without experience, the mean difference is 4·95 divisions.

Hence angular separation of the components

$$\tfrac{1}{2} \times 4{\cdot}95 \times 2{\cdot}34 = 5''{\cdot}79.$$

1892 *May* 9. *Readings of Pointer Scale.*

1st Position.	2nd Position.	1st Position.	2nd Position.
27·4	22·0	27·3	22·1
27·0	22·0	27·3	22·6
26·9	22·0	27·7	22·0
27·0	22·0	27·0	22·5
27·4	22·5	27·0	22·4

The mean difference is 4·99 divisions.

Hence angular separation of the components is

$$\tfrac{1}{2} \times 4{\cdot}99 \times 2{\cdot}34 = 5''{\cdot}84.$$

In Denning's *Telescopic Work* (p. 304) the separation is given as 5″·68.

VERTICAL DIAMETER OF SATURN.

1892 *April* 22. *Readings of Pointer Scale.*

1st position of movable image touching fixed image.	2nd position of movable image touching fixed image.
23·0	37·7
23·0	37·6
23·0	37·8

The mean difference is 14·7 divisions.

Hence vertical diameter is

$$\tfrac{1}{2} \times 14{\cdot}7 \times 2{\cdot}34 = 17''{\cdot}2.$$

I did not observe the angle the measured diameter made with the polar diameter, but from the westerly position of the planet I estimate it at over 30°. The polar diameter on this evening was

$$17''{\cdot}2,$$

so that the above is rather too small.

1892 *May* 9. *Readings of Pointer Scale.*

1st Position.	2nd Position.	1st Position.	2nd Position.
17·5	31·7	17·6	31·9
17·6	31·6	17·7	31·6
17·7	31·7		

The mean difference is 14·08 divisions.

Hence vertical diameter is

$$\tfrac{1}{2} \times 14{\cdot}08 \times 2{\cdot}34 = 16''{\cdot}5.$$

The diameter measured appeared to make about 20° with the polar diameter, which on this evening was

$$16''{\cdot}8.$$

Note on the calculated Value of the shifting of a Ray incident on a Parallel Plate.

Let the angle of incidence be ϕ, that of refraction ψ. Let t be the thickness of the plate, and μ its index of refraction. It is easily shown that the shift is

$$s = \frac{t \sin(\phi - \psi)}{\cos\psi}$$

$$= t \tan\phi \frac{\cos\phi \sin(\phi - \psi)}{\sin\phi \cos\psi}$$

$$= t \tan\phi \frac{(1 - \sin^2\phi)^{\frac{1}{2}}}{\sin\phi} \left\{ \sin\phi - \frac{(1 - \sin^2\phi)^{\frac{1}{2}} \sin\phi}{\mu \left(1 - \frac{\sin^2\phi}{\mu}\right)^{\frac{1}{2}}} \right\}$$

$$= t \tan \phi \left\{ (1 - \sin^2\phi)^{\frac{1}{2}} - \frac{1 - \sin^2\phi}{\mu} \left(1 - \frac{\sin^2\phi}{\mu^2} \right)^{\frac{1}{2}} \right\}$$

$$= t \tan \phi \left\{ 1 - \frac{\sin^2\phi}{2} - \frac{\sin^4\phi}{8} - \frac{\sin^6\phi}{16} \quad . \quad . \quad . \right.$$

$$\left. - \frac{1 - \sin^2\phi}{\mu} \left(1 + \tfrac{1}{2} \frac{\sin^2\phi}{\mu^2} + \tfrac{3}{8} \frac{\sin^4\phi}{\mu^4} + \tfrac{5}{16} \frac{\sin^6\phi}{\mu^6} + \right) \right\}$$

$$= t \tan \phi \left\{ \frac{\mu - 1}{\mu} - \sin^2\phi \left(\frac{1}{2} - \frac{1}{\mu} + \frac{1}{2\mu^3} \right) \right.$$

$$- \sin^4\phi \left(\frac{1}{8} - \frac{1}{2\mu^3} + \frac{3}{8\mu^5} \right)$$

$$- \sin^6\phi \left(\frac{1}{16} - \frac{3}{8\mu^5} + \frac{5}{16\mu^7} \right)$$

$$\left. - \text{ \&c.} \quad . \quad . \right\}$$

Taking $\mu = \frac{3}{2}$ and ϕ successively 5°, 10°, and 20°, then approximately

$$s = \frac{t}{3} \tan 5^\circ (1 - \cdot 00042)$$

$$s = \frac{t}{3} \tan 10^\circ (1 - \cdot 00156)$$

$$s = \frac{t}{3} \tan 20^\circ (1 - \cdot 00529).$$

The Lunar Eclipse, 1892 *May* 11 : *Observations made at Mr. Crossley's Observatory, Bermerside, Halifax.* By Edward Crossley, M.P., and Joseph Gledhill.

The weather here on the 11th was all that could be desired—a cloudless day and night. Owing, however, to the low position of the Moon (altitude about 18° when on the meridian) the naked-eye and other phenomena were not well seen before 10 o'clock. But as the Moon got higher the spectacle was very fine: the eclipsed portion was seen to be of a clear ruddy tinge, and the principal lunar seas, &c., were readily seen and identified with the help of an opera-glass. This beautiful colour disappeared about midnight, and gave place to a dull grey tinge.

While watching for the occultations of the stars given in the *Observatory* for May, an attempt was made to note the times when the general curve of the dark shadow reached some of the best-known craters.

The instrument used throughout the observations was the $9\frac{1}{3}$-inch Cooke refractor, power 66.

Before mid-eclipse :—

		G.M.T. h m s
Aristarchus,	1st edge of crater	9 18 16
Kepler,	„ „	25 27
Copernicus,	„ „	32 36
„	2nd „	33 30
Plato,	1st „	33 0
„	middle „	34 0
Archimedes,	1st edge „	37 0
„	middle „	38 2
„	2nd edge „	38 30
Aristotle,	1st „	43 7
Eudoxus,	„ „	43 45
Aristotle,	2nd „	44 30
Eudoxus,	„ „	45 15
Linné,	... ...	46 30
Menelaus,	... ...	53 30
Bessel,	... ...	51 24
Tycho,	1st „	10 8 38
„	2nd „	12 23
Proclus,	... ...	8 15

After mid-eclipse :—

Aristarchus,	... ...	11 49 22
Copernicus,	1st edge	53 22
„	middle of crater	54 27
„	2nd edge of crater	55 29
Proclus,	... ...	12 26 28

Occultations.

Careful watch was kept on the sky near the advancing limb of the Moon, but no stars could be seen until about 10 o'clock. Several very faint ones were seen as the time went on, but they could not be seen when close to the Moon's limb. The following observations were made: the earlier ones by Mr. Crossley at the telescope and a friend at the chronometer; after 11 o'clock I took charge of both instruments.

Time.	Phenomena.	Angle.	G.M.T. Observed Time.	Remarks.
h m		°	h m s	
9 45	D	142		No star seen near limb.
49	D	65		
10 16	D	112	10 15 26	
20	D	94	10 19 32	
26	R	355	...	Not seen until a little way from limb.
33	D	90	10 33 47	
43	D	103	10 40 51	Perhaps 1 sec. too late.
58	R	281	...	Faint star; not seen till away from limb.
11 0	D	57	...	Faint star; not seen till away from limb.
12	D	109	...	Faint star; not seen till away from limb.
31	R	327	11 28 34	
34	R	309	11 31 6	
42	R	332	11 39 35	
43	R	8	11 43 57	Very faint.
59	R	317	...	A bright star; lost owing to interruption.
12 31	R	306	12 28 15	Not seen double; examined it with 240.

The times of the occultation phenomena were taken to the nearest second. With regard to the times when the dark edge of the shadow touched a crater-wall, &c., they also were taken from the chronometer—i.e., when the shadow appeared just to touch a wall the chronometer time was recorded.

Bermerside, Halifax:
1892 *May* 13.

Occultations of Stars by the Eclipsed Moon, 1892 May 11, and other Phenomena, observed by the Rev. A. Freeman, M.A.

The stars are those of the list published in the *Observatory* of 1892 May. The telescope employed was my 6½-inch refractor, with an eyepiece having a power of 35 and a field of 1° 8′ in diameter. The time is dependent on comparisons of a solar chronometer with a trustworthy electric time-signal, May 4 and May 12, showing a daily gaining rate of only $0^{s}.14$ in the interval.

B.D. −19°.	Magn.	Occ.	G.M.T. h m s	Remarks.
4091	8·3	D.	10 17 25·25	Sudden.
4095	8·9	D.	10 35 51·25	Sudden.
4087	9·7	R.	11 3 4·25	Late.*
4099	8·2	D.	11 14 18·25	Final.†
4091	8·3	R.	11 35 2·25	Sudden.
4095	8·9	R.	11 44 14·25	Late.‡
4097	9·4	R.	11 48 9·25	Late.*

Phenomena of the Shadow.

h m	
9 11·4	Moon has entered shadow (late).
9 17·4	Shadow bisects Aristarchus.
9 31·4	Shadow touches Copernicus ring on E.
9 32·9	Shadow touches Mersenius on E.
9 34·0	Shadow covers Mersenius.
9 34·8	Shadow touches Copernicus ring on W.
10 9·2	Shadow touches Tycho ellipse on E.
10 11·1	Shadow bisects Tycho.
10 12·5	Shadow touches Tycho ellipse on W.
11 20·9	Shadow touches Tycho on S.
11 22·4	Shadow bisects Tycho.
11 24·0	Shadow touches Tycho on N.
12 37·5	Moon has left shadow (late).

There was a certain amount of haze about throughout the eclipse, varying in density but without cloud. The haze became

* Star first seen 22″·3 off limb of ☽ (= half greater axis of Tycho).
† This double star hung on the limb for two or three seconds.
‡ Star first seen 8″·2 off limb of ☽ (= quarter least axis of Tycho).

so dense at the end of the eclipse as to entirely conceal the reappearance of 4099, which was unfortunate. At the time of the greatest eclipse I estimated that only one-twentieth of the diameter of the Moon was uncovered, giving a magnitude of eclipse 0·950, closely agreeing with the *Nautical Almanac* 0·953. The eclipsed Moon at greatest obscuration appeared to have a bluish-grey tinge near the border of the shadow, and this tint gradually changed and finally became of a warm orange-grey tinge at the region furthest from the uneclipsed part of the Moon. There was a singular appearance within the shadow of bright curved wedge-like parts, with their bases on the east and west ends of the shadow's boundary, and with their points on the Moon's limits quite 40° from the illuminated part. The eastern wedge was the brighter of the two, but their magnitudes were the same. The existence of these wedges was manifest to the unaided eye, and to it the colour of the shadow at greatest obscuration was dark copper, it having been a few minutes previously bright copper. Two or three lunar peaks were visible near the S.W. point of Moon's limb, the loftiest projection a little S. of S.W.; there was a solitary, rather smaller, projecting peak near the S.E. point of the Moon's limb. During the progress of the eclipse the penumbra gave a pale straw colour to the lunar surface covered by it. The position of the observatory is $3^m\ 0^s$ E., and 51° 20′ N. approximately.

Murston Rectory, Sittingbourne:
1892 *May* 23.

Occultation of 73 *Piscium by Jupiter*, 1892 *May* 23, *observed at the Royal Observatory, Greenwich.*

(*Communicated by the Astronomer-Royal.*)

Notice was called to this phenomenon by Mr. Marth in the April number of the *Monthly Notices*, and as the morning was fine, an attempt was made to observe it with the 10-inch guiding telescope of the photographic equatorial. Owing to the low altitude of *Jupiter*, its limb was boiling violently, and accurate observation was only possible at occasional brief intervals of good definition.

The following notes describe what was seen at these moments:—

Phenomenon Observed.	Observer.	Sidereal Time.	Mean Time.
Disappearance.		h m s	d h m s
Star almost in contact with limb	A. C.	19 25 49	23 15 17 4
Star apparently bisected	,,	19 27 20	18 35
No trace seen of star	,,	19 32 44	23 58
Reappearance.			
Star suspected for a moment	,,	19 41 11	32 24
Star certainly reappeared	,,	19 46 7	37 19

It is probable that the time marked "Star suspected" is approximately correct for the reappearance, but the boiling of the limb made it impossible to verify it with certainty for some minutes more.

Mr. Marth's paper gave the Greenwich mean time of mid-occultation as $15^h\ 36^m{\cdot}6$, and the duration as $17^m{\cdot}2$. So far as the above rough observations are to be trusted, they seem to show that the Greenwich mean time of mid-occultation was $15^h\ 25^m{\cdot}6$, and the duration $12^m{\cdot}8$, or thereabouts.

The Greenwich observations of *Jupiter* at the end of 1891 gave as the error of Tabular R.A. $-0^s{\cdot}18$, the error of Tabular N.P D. being about $-0''{\cdot}1$.

The apparent place of the star according to the Greenwich Ten-Year Catalogue, 1880, was R.A. $0^h\ 59^m\ 16^s{\cdot}297$; N.P.D. $84°\ 55'\ 23''{\cdot}15$. The Glasgow Catalogue gives the R.A. $0^s{\cdot}12$ greater, the N.P.D. $1''{\cdot}74$ smaller.

The initials are those of Mr. Crommelin.

Erratum in Monthly Notices, May 1892, *p.* 517.

B.D. $-19°$ 4091	Dis.: for Sidereal Time	13	37	8·0	read	8·2
	for Mean Time	10	16	31·1	read	31·3

Observations of Swift's Comet (a 1892) made at the Royal Observatory, Greenwich.

(*Communicated by the Astronomer Royal.*)

The observations were made with the East, or Sheepshanks, equatorial, aperture 6·7 inches, by taking transits over two cross wires at right angles to each other, and each inclined 45° to the parallel of declination. Magnifying power, 55.

The observations are corrected for refraction, but not for parallax.

Greenwich Mean Solar Time.	Observer.	☄−★ R.A.	Corr. for Refraction.	Log factor of Parallax.	☄−★ N.P.D.	Corr. for Refraction.	Log factor of Parallax.	No. of Comps.	App. R.A. of ☄.	App. N.P.D. of ☄.	Comp. Star.
d h m s		m s	s		′ ″	″			h m s	° ′ ″	
May 14 12 25 15	A. C.	+1 40·53	−0·03	9·6027	− 3 16·8	−0·2	0·8358	5	23 10 46·81	60 45 53·9	*a*
14 12 25 15	,,	−1 16·64	+0·03	9·6027	+ 2 41·4	+0·2	0·8358	5	23 10 45·98	60 45 50·7	*b*
14 13 24 10	L.	+1 48·08	−0·01	9·6244	− 4 45·5	+0·3	0·7905	3	23 10 54·38	60 44 25·7	*a*
14 13 24 10	,,	−1 9·22	+0·00	9·6244	+ 1 9·9	−0·1	0·7905	3	23 10 53·37	60 44 18·9	*b*
15 12 48 51	B.	+1 48·43	−0·01	9·6180	− 1 0·2	0·0	0·8163	2	23 13 30·58	60 12 3·5	*c*
15 12 45 38	,,	+0 51·23	+0·02	9·6165	+ 4 15·5	+0·2	0·8188	3	23 13 29·19	60 12 18·6	*d*
15 12 48 51	,,	−2 1·85	+0·01	9·6180	+ 1 29·8	+0·1	0·8163	2	23 13 29·88	60 12 10·0	*e*
23 12 44 14	A. C.	+2 7·30	+0·04	9·6397	+12 27·8	+0·3	0·7974	2	23 33 54·93	56 9 38·9	*f*
23 12 44 14	,,	+0 2·95	+0·06	9·6397	+17 30·4	+0·5	0·7974	2	...	...	*g*
28 12 20 6	,,	+1 32·70	−0·04	9·6425	−14 1·6	−0·2	0·8048	3	23 45 47·35	53 56 34·9	*h*
28 12 25 0	,,	+0 29·47	−0·00	9·6467	− 1 33·0	0·0	0·8000	5	23 45 47·07	53 56 36·2	*i*
28 12 30 19	,,	−1 43·43	+0·04	9·6491	+17 36·8	+0·2	0·7950	3	...	...	*k*

Comparison Stars.

	Star's Name.	Mean R.A., 1892·0. h m s	Mean N.P.D. 1892·0. ° ′ ″	Authority.
a	W.B. (2) XXIII. 131 and 132	23 9 6·77	60 48 58·3	Weisse's Bessel, vol. ii.
b	W.B. (2) XXIII. 206 and 207	23 12 3·06	60 42 56·7	,, ,,
c	W.B. (2) XXIII. 194	23 11 42·61	60 12 51·2	,, ,,
d	W.B. (2) XXIII. 217	23 12 38·39	60 7 50·4	Second Armagh Catalogue, 1875.
e	63 Pegasi	23 15 32·19	60 10 27·8	Greenwich Seven-Year Catalogue, 1864.
f	B.D. + 33° 4744	23 31 47·96	55 56 58·9	Bonn Observations, vol. vi.
g	B.D. + 33° 4749	23 33 52·5	55 52	,, ,, vol. iv.
h	W.B. (2) XXIII. 907	23 44 15·00	54 10 25·5	Greenwich Ten-Year Catalogue, 1880.
i	W.B. (2) XXIII. 920	23 45 17·92	53 57 58·0	Weisse's Bessel, vol. ii.
k	B.D. + 36° 5126	23 47 31	53 39	Bonn Observations, vol. iv.

Notes.

Stars *a*, *b*, and *f* are all double stars, the components being nearly equal. In each case the mean of the places of the components has been used, as with the low power employed the duplicity was not observed.

On May 23 the comet was noted as very large and bright, with a bifurcated tail.

The places of the comet continue to agree closely with Berberich's Ephemeris.

The initials L., A.C., B., are those of Mr. Lewis, Mr. Crommelin, and Mr. Bryant respectively.

Observations of Comet 1892 a (Swift), made at the Royal Observatory, Cape of Good Hope.

(Communicated by D. Gill, LL.D., F.R.S., H.M. Astronomer.)

1892.	Cape Mean Time.	Comet−✶ Δα	Comet−✶ Δδ	No. of Comp. R.A.	No. of Comp. N.P.D.	Observer.	Comet App. R.A.	Log $p\times\Delta$	Comet App. Decl.	Log $p\times\Delta$	Red. to App. Place.	Comp. Star No.
	h m s	m s	′ ″				h m s		° ′ ″		s ″	
Mar. 8	16 58 31·8	−1 16·42	−1 54·8	6	6	F.	19 6 27·78	9·960	−30 2 54·4	0·213	−0·87 − 5·2	1
9	15 31 24·5	...	−3 26·6	...	2	F.	...	...	−29 16 33·3	0·453	−0·82 − 5·5	2
	15 41 22·0	−1 34·78	...	8	0	F.	19 11 3·31	9·704	...	...	−0·82 − 5·5	2
10	15 50 13·3	+1 3·35	+0 20·5	8	8	F.	19 15 53·53	9·693	−28 25 24·2	0·430	−0·83 − 5·7	3
11	15 42 1·5	−2 41·44	+0 14·5	8	8	F.	19 20 37·60	9·698	−27 34 2·3	0·464	−0·83 − 6·0	4
16	15 55 44·4	+2 49·93	+5 21·8	10	8	F.	19 43 51·53	9·672	−22 59 13·5	0·502	−0·74 − 7·3	5
19	14 54 32·7	...	+3 4·9	...	2	F.	...	...	−20 6 9·0	0·609	−0·70 − 8·1	6
	15 3 58·0	+2 54·25	...	2	0	F.	19 56 56·74	9·703	...	...	−0·70 − 8·1	6
20	15 32 48·9	−0 23·36	+2 34·1	20	10	F.	20 1 34·52	9·682	−19 4 28·2	0·574	−0·71 − 8·4	7
21	15 56 2·1	−1 47·96	−2 39·8	16	12	F.	...	9·661	...	0·560	−0·71 − 8·7	8
23	15 46 25·6	−1 35·87	−1 56·6	12	12	F.	20 14 30·87	9·665	−16 0 9·9	0·588	−0·69 − 9·1	9
26	16 3 0·6	...	−2 24·8	...	8	F.	...	...	−12 51 31·7	0·602	−0·66 − 9·8	10
	16 15 58·8	−1 35·78	...	12	0	F.	20 27 7·04	9·629	...	...	−0·66 − 9·8	10
29	16 3 52·0	...	−0 56·0	...	10	F.	...	...	...	0·628	−0·63 −10·5	11
	16 31 48·7	+0 24·18	...	6	0	F.	...	9·604	...	...	−0·63 −10·5	11
30	16 2 22·1	...	−1 22·0	...	4	F.	...	...	...	0·637	−0·63 −10·6	12
Apr. 1	16 16 55·3	+1 23·73	−3 5·9	12	12	F.	20 51 6·39	9·620	− 6 30 2·9	0·647	−0·61 −11·1	13
3	16 5 21·9	+0 47·77	−3 46·9	12	12	F.	20 58 47·16	9·631	− 4 24 1·6	0·665	−0·61 −11·4	14

The observations are corrected for refraction.

Assumed Mean Places of Comparison Stars.

Comp. Star No.	R.A. 1892·0.	Declination. 1892·0.	Authority.
	h m s	° ′ ″	
1	19 7 45·07	−30 0 54·4	Stone 10436.
2	19 12 38·91	−29 13 1·2	C.Z. XIX.^{h} 504.
3	19 14 51·01	−28 25 39·0	C.Z. XIX.^{h} 599 and comparison with C.Z. XIX.^{h} 480.
4	19 23 19·87	−27 34 10·8	A.G.C. 26690.
5	19 41 2·34	−23 4 28·0	A.G.C. 27096.
6	19 54 3·19	−20 9 5·8	Cincinnati Z. 3321.
7	20 1 58·59	−19 6 53·9	Cincinnati Z. 3341.
8	20 7 47	−18 0	B.D.−18°, 5624.
9	20 16 7·43	−15 58 4·2	Yarnall 9046.
10	20 28 43·48	−12 48 57·1	Santini 1868.
11	20 38 55	− 9 39	B D.−9°, 5563.
12	20 44 34	− 8 36	B.D.−8°, 5490.
13	20 49 43·27	− 6 26 45·9	Munich Z. 4043.
14	20 58 0·00	− 4 20 3·3	Schj. 8465.

Notes.

March 9.—The comet shows a sharp nucleus, equal to a star of 9½ magnitude; the head is very bright and is visible to the naked eye as a hazy star of the fourth magnitude.

March 10.—Nucleus admits of very accurate observation.

March 19.—Thick fog prevented further observation.

March 21.—Well-defined nucleus, equal to star 9½ magnitude.

March 23.—Very bad definition; strong wind.

March 26.—A short faint tail visible in the finder.

March 30.—Fogged up completely before any right ascension could be secured.

April 1.—Nucleus sharp and bright, equal to a star 9 magnitude. Faint straight tail about 4° long.

April 2.—Nucleus not well defined; stars very unsteady.

All the observations have been made by Mr. W. H. Finlay.

Observations of Wolf's Periodic Comet, made at the Cambridge Observatory with the Northumberland Equatoreal and Square Bar Micrometer. By A. Graham, M.A., Chief Assistant.

(*Communicated by the Secretaries.*)

1891.	Greenwich M.T.	R.A. ☄	Decl. ☄	No. of Comp.	Mean Places of Comparison Stars. R.A. 1891·0.	Decl. 1891·0.	Authority.
		h m s	° ′ ″		h m s	° ′ ″	
Aug.	15·46266	2 51 54·72	27 44 11·3	5	2 49 24·23	27 48 53·7	4 Meridian Observations, Cambridge.
	18·48913	2 59 45·09	27 23 39·9	5	2 59 5·85	27 26 41·7	3 „ „ „
	28·46021	3 24 27·97	25 44 33·0	5	3 24 45·94	25 47 9·2	4 „ „ „
	28·46021	3 24 28·28	25 44 34·0	5	3 26 0·96	25 50 6·6	1 „ „ „
	29·43224	3 26 45·27	25 32 24·2	5	3 30 37·32	25 38 20·9	4 „ „ „
Sept.	1·40023	3 33 38·76	24 51 46·3	10	3 34 15·63	24 58 35·5	2 „ „ „
	2·42124	3 35 58·67	24 36 35·1	6	3 38 39·42	24 29 47·7	3 „ „ „
	8·40088	3 48 57·99	22 57 34·4	10	3 50 36·04	22 51 29·6	3 „ „ „
	9·45960	3 51 8·85	22 38 8·3	5	3 52 42 04	22 40 38·8	3 „ „ „
	10·41493	3 53 4·99	22 20 6·9	5	3 50 25·59	22 9 48·5	3 „ „ „
	11·42903	3 55 7·53	22 0 22·1	5	3 58 15·00	21 47 0·4	A^1 Tauri, Nautical Almanac.
	12·42207	3 57 3·85	21 40 29·6	10	3 58 15·00	21 47 0·4	„ „ „
	12·42207	3 57 3·73	21 40 30·3	10	3 58 53·04	21 42 50·9	A^2 Tauri, Greenwich Catalogue, 1880.
	14·43044	4 0 54·53	20 58 52·5	10	4 0 44·19	20 58 6·9	2 Meridian Observations, Cambridge.
	14·43044	4 0 54·69	20 58 51·0	10	4 1 19·04	20 58 14·0	4 „ „ „
	28·41396	4 23 20·21	15 14 2·2	10	4 20 7·98	15 22 14·4	71 Tauri, Greenwich Catalogue, 1872.
	28·41396	4 23 20·12	15 13 59·9	10	4 23 55·60	15 23 56·8	80 Tauri, Greenwich Catalogue, 1880.
Oct.	3·42147	4 29 19·01	12 49 30·4	10	4 27 39·46	13 1 18·4	3 Meridian Observations, Cambridge.
	3·42147	4 29 19·40	12 49 27·0	10	4 30 19·02	12 53 54·6	(*a*) „ „ „

	9·42594	4 34 56·37	9 44 41·6	1	4 33 44·48	9 40 0·3	3	,,	,,	,,
	12·44611	4 37 7·39	8 8 14·2	5	4 35 17·59	8 4 7·3	3	,,	,,	,,
	12·44611	4 37 7·20	8 8 15·9	5	4 40 41·34	8 7 12·8	3	,,	,,	,,
	28·46773	4 41 33·09	− 0 32 51·8	10	4 42 42·07	− 0 35 5·2	3	,,	,,	,,
	28·46773	4 41 33·16	− 0 32 53·1	10	4 43 26·14	− 0 34 9·1	3	,,	,,	,,
	30·45186	4 41 18·74	− 1 35 6·7	11	4 39 7·66	− 1 38 10·6	3	,,	,,	,,
	30·45186	4 41 18·65	− 1 35 8·5	11	4 43 7·04	− 1 32 58·3	2	,,	,,	,,
Nov.	2·46056	4 40 39 92	− 3 6 55·7	4 (*b*)	4 40 22·01	− 3 6 32·7	3	,,	,,	,,
Dec.	2·47738	4 23 38·52	−13 32 29·7	5	4 20 57·47	−13 31 48·6	3	,,	,,	,,
	2·47738	4 23 38 63	−13 32 29·4	5	4 25 25·29	−13 30 23·1	3	,,	,,	,,
	4·43092	4 22 27·42	−13 51 2·5	5	4 23 56·73	−13 54 6·5	3	,,	,,	,,
	4·43092	4 22 27·37	−13 51 2·3	5	4 26 23·93	−13 52 41·2	3	,,	,,	,,

The corrections for aberration and parallax are applied.

(*a*) This star is very faint. The right ascension given here depends on one meridian observation, the declination on three.
(*b*) Caught only occasional glimpses of the comet; seldom long enough for a complete observation.

Places of Nova Aurigæ, obtained with the Cambridge Transit-Circle, reduced to Mean Equinox, 1892·0.

1892.	R.A. 1892·0. h m s	Decl. 1892·0. ° ′ ″	1892.	R.A. 1892·0. h m s	Decl. 1892·0. ° ′ ″
Feb. 5	5 25 3·439	30 21 49·38	Feb. 16	5 25 3·392	30 21 48·64
11	·297	50·64	18	·450	49·47
12	·349	48·75	22	·289	49·40
13	·374	48·64	25	·414	49·58

The Observatory, Cambridge:
1892 *June* 2.

Sextant Observations of Swift's Comet taken on board the ship "Earnock" from Bluff Harbour, N.Z., to London.

By George F. Parson, Master of the ship "Earnock."

1892.	Approx. time Ship.	Latitude.	Longitude.	G.M.T.	Mars.	Distance from Vega.	Distance from Altair.	
				h m s	° ′	° ′	° ′	
Apr. 8	4 A.M.	29 20 S.	28 20 W.					A small comet first seen in Eastern sky, but no observations could be taken until April 26.
26	4 A.M.	3 6 N.	31 20 W.	Apr. 25 18 10 14	53 20			
				18 13 24		53 9		
				18 16 9			37 24	
28	3.30 A.M.	7 23 N.	34 20 W.	27 17 36 00	54 34			
				17 39 20		53 15		
				17 41 40			39 4	
May 2	3.30 A.M.	18 38 N.	39 50 W.	May 1 17 57 00	57 16			Very faint, and frequently obscured by light clouds.
				18 8 30		54 7		
				18 12 20			42 39	

Only faintly seen after this, owing to cloudy weather and early daylight.

Note on Damoiseau's "Tables Ecliptiques des Satellites de Jupiter."

By A. M. W. Downing, M.A.

An examination of the fundamental numbers for the formation of the arguments of the inequalities, given by Damoiseau, pp. iii–viii of the Introduction to his Tables, has recently been made here, for the purpose of verifying (and, if necessary, carrying on) Adams' corrections to Damoiseau's values of the arguments, given on p. 17 of the Appendix to the *Nautical Almanac*, 1881. As it appears more convenient to have the corrected numbers than to apply corrections to the arguments formed from the erroneous numbers, it may be worth while putting on record the result of the examination of Damoiseau's work. It should be noted that the object of the corrections tabulated below is to make the arguments consistent with the data given at the top of p. iii of the Introduction.

First Satellite.

Argument.	*For.*	*Read.*
	s °	s °
$u_{\rm i}-u_{\rm ii}$	$+i$ 180°7279427	$+i$ 180°7279424
$u_{\rm i}-\pi_{\rm iii}$	1 18·9465 $+i$ 0·1344456	1 18·9459 $+i$ 0·1344372
$u_{\rm i}-\pi_{\rm iv}$	$+i$ 0·1436792	$+i$ 0·1436793
$u_{\rm i}-2u_{\rm ii}+\pi_{\rm iii}$	$+i$ 1·3214486	$+i$ 1·3214475
$u_{\rm i}-2u_{\rm ii}+\pi_{\rm iv}$	$+i$ 1·3122065	$+i$ 1·3122054

Second Satellite.

Argument.	*For.*	*Read.*
	s °	s °
$U-\pi'$	$+i$ 3°5029156	$+i$ 3°5029157
$U-u_{\rm o}$	$+i$ 3·2076333	$+i$ 3·2076334
$u_{\rm ii}-u_{\rm iii}$	11 27·7519 $+i$ 181·4617960	10 27·7519 $+i$ 181·4617964
$u_{\rm ii}-\pi_{\rm iii}$	$+i$ 0·2699661	$+i$ 0·2699663
$u_{\rm ii}-\pi_{\rm iv}$	$+i$ 0·2885252	$+i$ 0·2885256
$u_{\rm i}-2u_{\rm ii}+\pi_{\rm iii}$	$+i$ 2·6536288	$+i$ 2·6536267
$u_{\rm i}-2u_{\rm ii}+\pi_{\rm iv}$	$+i$ 2·6350694	$+i$ 2·6350674
$u_{\rm ii}-\Pi$	$+i$ 0·2953146	$+i$ 0·2953149
$u_{\rm ii}-\Lambda_{\rm ii}$	8 21·8069 $+i$ 0·4128461	8 21·8269 $+i$ 0·4128463
$u_{\rm ii}-\Lambda_{\rm iii}$	$+i$ 0·3201667	$+i$ 0·3201668
$u_{\rm ii}-\Lambda_{\rm iv}$	$+i$ 0·3020441	$+i$ 0·3020443

Third Satellite.

Argument.	*For.*	*Read.*
	s °	s °
$u_{\rm ii}-u_{\rm iii}$	$+i$ 5°8950578	$+i$ 5°8950600
$u_{\rm iii}-\pi_{\rm iii}$	1 19·3500 $+i$ 0·5443534	1 19·3502 $+i$ 0·5443535
$u_{\rm i}-2u_{\rm ii}+\pi_{\rm iii}$	$+i$ 5·3507118	$+i$ 5·3507070
$u_{\rm i}-2u_{\rm ii}+\pi_{\rm iv}$	$+i$ 5·3132886	$+i$ 5·3132845
$u_{\rm iii}-\Pi$	$+i$ 0·5954489	$+i$ 0·5954659
$u_{\rm iii}-\Lambda_{\rm iii}$	6 10·9058	6 10·9050
$u_{\rm iii}-\Lambda_{\rm ii}$	$+i$ 0·8324332	$+i$ 0·8324532

FOURTH SATELLITE.

Argument.	*For.*		*Read.*	
	s °		s °	
$U-\pi'$	0 3·4178 + i	16°·5123047	0 3·4181 + i	16°·5123037
$U-u_0$	9 6·1550 + i	15·1203809	9 8·1553 + i	15·1203800
$u_{iii}-u_{iv}$	2 24·9629 + i	121·6066164	2 24·9726 + i	121·6066143
$u_{ii}-u_{iv}$	3 16·2853 + i	256·9946780	3 16·3121 + i	256·9946770
$u_{iv}-\pi_{iv}$	6 3·4433 + i	1·3600749	6 3·4506 + i	1·3600734
$u_{iv}-\pi_{iii}$	1 18·9271 + i	1·2726106	1 18·9343 + i	1·2725873
$u_{iv}-\Pi$	1 20·5205 + i	1·3921007	1 20·5277 + i	1·3920776
$u_{iv}-\Lambda_{iv}$	+ i	1·4238223	+ i	1·4237991
$u_{iv}-\Lambda_{iii}$	6 10·4045 + i	1·5092494	6 10·4118 + i	1·5092261
$u_{iv}-\Lambda_{ii}$	8 21·9415 + i	1·9461073	8 21·9488 + i	1·9461056

The greater number of these corrections are included in Adams' list mentioned above, and have therefore been applied in forming the times of eclipses given in the *Nautical Almanac* since 1881.

I suppose it is generally known that both the coefficient and argument of the inequality depending on the Great Inequality of *Jupiter* and *Saturn* (included in Damoiseau's Table III for the Second, Third, and Fourth Satellites) are erroneous. According to Souillart, the value of the argument is $5\bar{u}-2u_0-16°\,633$; and the coefficients are 0ˢ·711, 2ˢ·110, and 11ˢ·644 for the Second, Third, and Fourth Satellites respectively. In the continuation of Adams' Tables, used in the *Nautical Almanac* for 1891 and subsequent years, Adams appears to have adopted nearly identical expressions to those found by Souillart for these inequalities.

Nautical Almanac Office:
1892 *June* 9.

Data for computing the Positions of the Satellites of Jupiter, 1892.

By A. Marth.

The following data for computing the positions of the satellites during the present apparition of *Jupiter* correspond to the data for the preceding apparition on pages 518–523 of Vol. 51 of the *Monthly Notices*. The motions of the longitude and of arguments and the inequalities corresponding to the arguments are to be found there on pages 524–539.

First Satellite.

Greenwich Noon.	Longitude. $l_1 - O$	S_1	Arguments. α_1	β_1	γ_1	δ_1	ϵ_1
1892.	°	°					
May 21	227·7103	+·0081	·1411	·035	·882	·057	·259
31	102·5999	80	·8141	·454	·530	·709	·284
June 10	337·4894	80	·4871	·872	·179	·362	·319
20	212·3790	79	·1601	·290	·827	·014	·333
30	87·2686	79	·8332	·708	·475	·666	·358
July 10	322·1581	+·0078	·5062	·127	·124	·319	·383
20	197·0477	78	·1792	·545	·772	·971	·407
30	71·9372	78	·8522	·963	·420	·623	·432
Aug. 9	306·8268	77	·5252	·381	·0 8	·275	·457
19	181·7164	77	·1982	·800	·717	·928	·481
29	56·6059	76	·8712	·218	·365	·580	·506
Sept. 8	291·4955	+·0076	·5442	·636	·013	·232	·531
18	166·3850	75	·2173	·054	·662	·884	·555
28	41·2746	75	·8903	·473	·310	·537	·580
Oct. 8	276·1642	74	·5633	·891	·958	·189	·605
18	151·0537	74	·2363	·309	·607	·841	·630
28	25·9433	74	·9093	·727	·255	·494	·654
Nov. 7	260·8328	+·0073	·5823	·146	·903	·146	·679
17	135·7224	73	·2553	·564	·552	·798	·704
27	10·6120	72	·9284	·982	·200	·450	·728
Dec. 7	245·5015	72	·6014	·400	·848	·103	·753
17	120·3911	71	·2744	·819	·497	·755	·778
27	355·2806	71	·9474	·237	·145	·407	·802
1893.							
Jan. 6	230·1702	+·0070	·6204	·655	·793	·059	·827
16	105·0598	70	·2934	·073	·442	·712	·852
26	339·9493	69	·9664	·492	·090	·364	·876
Feb. 5	214·8389	69	·6394	·910	·738	·016	·901
15	89·7284	68	·3125	·328	·387	·668	·926
25	324·6180	68	·9855	·746	·035	·321	·951
Mar. 7	199·5076	+·0068	·6585	·165	·683	·973	·975

	Inclination. γ_1	Node. $O - \Gamma_1$		Inclination. γ_1	Node. $O - \Gamma_1$
	°	°		°	°
1892 May 11	0·0083	113·0	1892 Oct. 8	0·0084	117·0
June 10	83	113·7	Nov. 7	84	118·0
July 10	83	114·5	Dec. 7	85	119·0
Aug. 9	84	115·3	1893 Jan. 6	85	120·0
Sept. 8	84	116·1	Feb. 5	86	121·1
Oct. 8	84	117·0	Mar. 7	86	122·3

Greenwich Noon.	*First Satellite.* Arguments. ζ_1	η_1	θ_1	*Second Satellite.* Longitude. l_2-O	S_2	Arguments. α_2	β_2
1892.				°	°		
May 21	·163	·584	·418	22·3110	+·0048	·07055	·035
31	·185	·605	·438	316·0583	46	·90706	·454
June 10	·207	·625	·459	249·8055	45	·74357	·872
20	·228	·646	·479	183·5528	43	·58007	·290
30	·250	·667	·500	117·3001	41	·41658	·708
July 10	·272	·688	·521	51·0473	+·0040	·25309	·127
20	·294	·708	·541	344·7946	38	·08959	·545
30	·315	·729	·562	278·5418	36	·92610	·963
Aug. 9	·337	·750	·582	212·2891	35	·76260	·381
19	·359	·771	·603	146·0363	34	·59911	·800
29	·381	·791	·624	79·7836	32	·43562	·218
Sept. 8	·402	·812	·644	13·5308	+·0030	·27212	·636
18	·424	·833	·665	307·2781	28	·10863	·054
28	·446	·854	·685	241·0254	26	·94514	·473
Oct. 8	·468	·874	·706	174·7726	25	·78164	·891
18	·489	·895	·727	108·5199	23	·61815	·309
28	·511	·916	·747	42·2671	21	·45466	·727
Nov. 7	·533	·937	·768	336·0144	+·0020	·29116	·146
17	·555	·957	·788	269·7616	18	·12767	·564
27	·576	·978	·809	203·5089	16	·96418	·982
Dec. 7	·598	·999	·829	137·2562	15	·80068	·400
17	·620	·020	·850	71·0034	13	·63719	·819
27	·642	·040	·871	4·7507	11	·47369	·237
1893.							
Jan. 6	·663	·061	·891	298·4979	+·0010	·31020	·655
16	·685	·082	·912	232·2452	08	·14671	·073
26	·707	·102	·932	165·9924	07	·98321	·492
Feb. 5	·729	·123	·953	99·7397	05	·81972	·910
15	·750	·144	·974	33·4869	03	·65623	·328
25	·772	·165	·994	327·2342	02	·49273	·746
Mar. 7	·794	·185	·015	260·9815	·0000	·32924	·165

	Inclination. γ_2	Node. $O-\Gamma_2$	
1892.	°	°	
May 11	0·4904	129·16	95
June 10	·4902	130·11	96
July 10	·4899	131 07	95
Aug. 9	·4897	132·02	96
Sept. 8	·4895	132·98	96
Oct. 8	0·4892	133·94	

Second Satellite.

Greenwich Noon. 1892.	Arguments. γ_2	δ_2	ϵ_2	ζ_2	η_2	θ_2	ι_2	κ_2	λ_2
May 21	·907	·487	·653	·163	·084	·918	·759	·654	·488
31	·722	·302	·469	·185	·105	·938	·784	·512	·345
June 10	·537	·118	·285	·207	·125	·959	·809	·369	·202
20	·352	·934	·101	·228	·146	·979	·833	·226	·059
30	·166	·750	·917	·250	·167	·000	·858	·083	·917
July 10	·981	·565	·733	·272	·188	·021	·883	·941	·774
20	·796	·381	·548	·294	·208	·041	·907	·798	·631
30	·611	·197	·364	·315	·229	·062	·932	·655	·488
Aug. 9	·425	·013	·180	·337	·250	·082	·957	·512	·345
19	·240	·828	·996	·359	·271	·103	·981	·370	·202
29	·055	·644	·812	·381	·291	·124	·006	·227	·059
Sept. 8	·870	·460	·628	·402	·312	·144	·031	·084	·916
18	·684	·276	·444	·424	·333	·165	·055	·941	·773
28	·499	·092	·260	·446	·354	·185	·080	·799	·630
Oct. 8	·314	·907	·076	·468	·374	·206	·105	·656	·488
18	·129	·723	·892	·489	·395	·227	·130	·513	·345
28	·944	·539	·708	·511	·416	·247	·154	·370	·202
Nov. 7	·758	·355	·523	·533	·437	·268	·179	·228	·059
17	·573	·170	·339	·555	·457	·288	·204	·085	·916
27	·388	·986	·155	·576	·478	·309	·228	·942	·773
Dec. 7	·203	·802	·971	·598	·499	·329	·253	·799	·630
17	·017	·618	·787	·620	·520	·350	·278	·657	·487
27	·832	·433	·603	·642	·540	·371	·302	·514	·344
1893. Jan. 6	·647	·249	·419	·663	·561	·391	·327	·371	·201
16	·462	·065	·235	·685	·582	·412	·352	·228	·059
26	·276	·881	·051	·707	·602	·432	·376	·086	·916
Feb. 5	·091	·696	·867	·729	·623	·453	·401	·943	·773
15	·906	·512	·683	·750	·644	·474	·426	·800	·630
25	·721	·328	·498	·772	·665	·494	·451	·657	·487
Mar. 7	·535	·144	·314	·794	·685	·515	·475	·515	·344

	Inclination. γ_2	Node. $\Theta-\Gamma_2$	
	°	°	
1892 Oct. 8	0·4892	133·94	96
Nov. 7	·4890	134·90	96
Dec. 7	·4887	135·86	97
1893 Jan. 6	·4885	136·83	96
Feb. 5	·4882	137·79	97
Mar. 7	0·4880	138·76	

Third Satellite.

Greenwich Noon.	Longitude. l_3-0	S_3	Arguments. α_3	β_3	γ_3	δ_3	ϵ_3
1892.	°	°					
May 21	189·6114	+·0039	·9513	·1177	·0353	·328	·619
31	332·7875	37	·3489	·5154	·4535	·127	·058
June 10	115·9636	35	·7464	·9130	·8718	·925	·497
20	259·1397	33	·1439	·3107	·2900	·724	·936
30	42·3158	31	·5414	·7083	·7083	·523	·375
July 10	185·4919	+·0029	·9389	·1060	·1265	·321	·814
20	328·6680	27	·3364	·5036	·5448	·120	·253
30	111·8441	25	·7339	·9013	·9630	·918	·692
Aug. 9	255·0202	23	·1314	·2990	·3813	·717	·131
19	38·1963	21	·5289	·6996	·7996	·515	·570
29	181·3724	19	·9265	·0943	·2178	·314	·009
Sept. 8	324·5485	+·0017	·3240	·4919	·6361	·112	·448
18	107·7246	15	·7215	·8896	·0543	·911	·887
28	250·9007	13	·1190	·2872	·4726	·709	·326
Oct. 8	34·0768	11	·5165	·6849	·8908	·507	·765
18	177·2529	09	·9140	·0826	·3091	·306	·204
28	320·4291	07	·3115	·4802	·7273	·105	·643
Nov. 7	103·6052	+·0005	·7090	·8779	·1456	·903	·082
17	246·7813	+·0003	·1065	·2755	·5638	·702	·521
27	29·9574	+·0001	·5041	·6732	·9821	·500	·960
Dec. 7	173·1335	−·0001	·9016	·0708	·4003	·299	·399
17	316·3096	−·0003	·2991	·4685	·8186	·097	·838
27	99·4857	−·0005	·6966	·8662	·2368	·896	·277
1893.							
Jan. 6	242·6618	−·0007	·0941	·2638	·6551	·694	·716
16	25·8379	09	·4916	·6615	·0734	·493	·155
26	169·0140	11	·8891	·0591	·4916	·291	·594
Feb. 5	312·1901	13	·2866	·4568	·9099	·090	·033
15	95·3662	15	·6842	·8544	·3281	·888	·472
25	238·5423	17	·0817	·2521	·7464	·687	·911
Mar. 7	21·7184	−·0019	·4792	·6498	·1646	·485	·350

	Inclination. γ_3	Node. $0-\Gamma_3$		Inclination. γ_3	Node. $0-\Gamma_3$
	°	°		°	°
1892 May 11	0·1336	121·48	1892 Oct. 8	0·1319	122·02
June 10	·1333	121·57	Nov. 7	·1315	122·15
July 10	·1330	121·67	Dec. 7	·1311	122·29
Aug. 9	·1326	121·78	1893 Jan. 6	·1307	122·44
Sept. 8	·1322	121·90	Feb. 5	·1303	122·59
Oct. 8	0·1319	122·02	Mar. 7	0·1299	122·75

Greenwich Noon. 1892.		Third Satellite. Arguments. ζ_3	η_3	θ_3	ι_3	Fourth Satellite. Longitude. $l_4-\Omega$	S_4	Arg. α_4
						°	°	
May	21	·163	·584	·418	·872	251·3648	−·0011	·28925
	31	·185	·605	·438	·269	107·0755	15	·88839
June	10	·207	·625	·459	·665	322·7863	20	·48753
	20	·228	·646	·479	·062	178·4970	24	·08667
	30	·250	·667	·500	·458	34·2077	29	·68581
July	10	·272	·688	·521	·855	249·9185	−·0034	·28496
	20	·294	·708	·541	·251	105·6292	38	·88410
	30	·315	·729	·562	·648	321·3400	43	·48324
Aug.	9	·337	·750	·582	·044	177·0507	48	·08238
	19	·359	·771	·603	·441	32·7614	52	·68152
	29	·381	·791	·624	·837	248·4722	57	·28067
Sept.	8	·402	·812	·644	·234	104·1829	−·0062	·87981
	18	·424	·833	·665	·630	319·8937	66	·47895
	28	·446	·854	·685	·027	175 6044	71	·07809
Oct.	8	·468	·874	·706	·423	31·3151	75	·67723
	18	·489	·895	·727	·820	247·0259	80	·27637
	28	·511	·916	·747	·216	102·7366	85	·87552
Nov.	7	·533	·937	·768	·613	318·4474	−·0089	·47466
	17	·555	·957	·788	·009	174·1580	·0094	·07380
	27	·576	·978	·809	·406	29·8688	·0098	·67294
Dec.	7	·598	·999	·829	·802	245·5796	·0103	·27208
	17	·620	·020	·850	·199	101·2903	·0107	·87123
	27	·642	·040	·871	·595	317·0011	·0112	·47037
1893.								
Jan.	6	·663	·061	·891	·992	172·7118	−·0117	·06951
	16	·685	·082	·912	·388	28·4225	·0121	·66865
	26	·707	·102	·932	·785	244·1333	·0126	·26779
Feb.	5	·729	·123	·953	·181	99·8440	·0130	·86694
	15	·750	·144	·974	·578	315·5548	·0134	·46608
	25	·772	·165	·994	·974	171·2655	·0139	·06522
Mar.	7	·794	·185	·015	·371	26·9762	−·0143	·66436

1892.		Inclination. γ_4	Node. $\Omega-\Gamma_4$
		°	°
May	11	0·3489	29·15
June	10	·3491	29·12
July	10	·3493	29·08
Aug.	9	·3495	29·04
Sept.	8	·3496	29·00
Oct.	8	0·3497	28·95

Fourth Satellite.

Greenwich Noon. 1892.	Arguments. β_4	γ_4	δ_4	ϵ_4	ζ_4	η_4	θ_4
May 21	·328	·623	·819	·108	·539	·364	·206
31	·127	·222	·414	·302	·739	·581	·405
June 10	·925	·821	·008	·496	·938	·797	·605
20	·724	·420	·603	·690	·137	·014	·804
30	·523	·019	·198	·883	·337	·231	·004
July 10	·321	·618	·792	·077	·536	·448	·203
20	·120	·217	·387	·271	·735	·664	·403
30	·918	·816	·981	·465	·935	·881	·602
Aug. 9	·717	·415	·576	·658	·134	·098	·802
19	·515	·014	·171	·852	·334	·315	·001
29	·314	·613	·765	·046	·533	·531	·201
Sept. 8	·112	·212	·360	·240	·732	·748	·400
18	·911	·811	·955	·434	·932	·965	·600
28	·709	·410	·549	·627	·131	·182	·799
Oct. 8	·507	·009	·144	·821	·330	·398	·999
18	·306	·608	·739	·015	·530	·615	·198
28	·105	·207	·331	·209	·729	·832	·398
Nov. 7	·903	·806	·928	·402	·929	·049	·597
17	·702	·405	·522	·596	·128	·266	·797
27	·500	·004	·117	·790	·328	·482	·996
Dec. 7	·299	·603	·712	·984	·527	·699	·196
17	·097	·202	·306	·178	·726	·916	·395
27	·896	·801	·901	·371	·925	·133	·595
1893. Jan. 6	·694	·400	·496	·565	·125	·349	·795
16	·493	·999	·090	·759	·324	·566	·994
26	·291	·598	·685	·953	·524	·783	·194
Feb. 5	·090	·197	·280	·146	·723	·000	·393
15	·888	·796	·874	·340	·922	·216	·593
25	·687	·395	·469	·534	·122	·433	·792
Mar. 7	·485	·994	·063	·728	·321	·650	·992

	Inclination. γ_4	Node. $0-\Gamma_4$
1892 Oct. 8	0°·3497	28°·95
Nov. 7	·3497	28·90
Dec. 7	·3498	28·84
1893 Jan. 6	·3498	28·79
Feb. 5	·3497	28·73
Mar. 7	0·3496	28·68

Col. Cooper's Observatory:
Markree, Collooney, Ireland.

Note on the Conjunction of Venus and Jupiter observed in Australia, 1892 February 6. By A. Marth.

Mr. Russell, the Director of the Sydney Observatory, has been good enough to send me some letters which he has received referring to the conjunction of *Venus* and *Jupiter* on February 6. The weather in general seems to have been unfavourable. At Sydney "a dense mantle of cloud blotted out the planets the whole evening." But in some parts of New South Wales the sky has been more propitious and very clear.

At Gara Station, about ten miles from Armidale (lat. 30° 32′ S., long. 151° 38° E.), Mr. R. P. Sellors and a party of friends saw the planets separate till about $7^h\ 35^m$ Sydney M. T., but by $7^h\ 45^m$ they appeared as one.

At Monteagle, Bathurst, Mr. J. B. Dulhunty and a party of friends watched the two planets approaching conjunction, and at $7^h\ 40^m$ Sydney M. T. could not tell whether they did not appear to the naked eye as one star.

The distances between the rim of *Jupiter* and the nearest edge of the illuminated disc of *Venus* at the two times recorded at Gara Station were 98″ and 74″, so that the distance of the two edges at which the eyes of Mr. Sellors and his friends ceased to separate the two planets is between these limits.

Preliminary Address of the General Committee of the World's Congress Auxiliary on Mathematics and Astronomy.

The following circular has been received from Professor G. E. Hale:—

"The World's Congress Auxiliary is an organisation maintained by the World's Columbian Exposition, and approved by the Government of the United States, for the purpose of organising a series of Congresses or Conventions to be held during the progress of the Exposition in 1893, and which will bring together the leading scholars of the world for the mutual interchange of ideas on topics bearing on human progress.

"A scientific Congress to present and consider investigations in its special lines of research from all parts of the world, cannot fail to exert an important influence in the progress of scientific development. The personal interchange of views in regard to methods of observation and investigation will undoubtedly be productive of mutual benefit to the members of the Congress, as well as of lasting value to science.

"The General Committee on Mathematics and Astronomy presents this Preliminary Address, cordially inviting the co-operation of all persons and societies interested in this department of physical science.

"As the matter assigned to this committee covers a large field in physical science, it has been thought advisable to arrange the subjects to be considered under the following chapters and sections, in which, in consideration of its recent development and growing importance, astro-physics has been assigned a separate chapter from other branches of general astronomy.

"The following are some of the topics suggested for consideration under the several chapters:—

"CHAPTER I.—*Pure Mathematics.* Section *a*, History and Bibliography; Section *b*, Arithmetic and Theory of Numbers; Section *c*, Analysis; Section *d*, Geometry; Section *e*, Analytical Mechanics; Section *f*, Mathematical Physics.

"CHAPTER II.—*Astronomy.* Section *a*, History of Astronomy; Section *b*, Astronomical Instruments; Section *c*, Methods of Observation; Section *d*, Physical Astronomy; Section *e*, Observatory Buildings.

"CHAPTER III.—*Astro-physics.* Section *a*, Spectrum Analysis; Section *b*, Astronomical Photography; Section *c*, Stellar Photometry.

"The object of this Preliminary Address is simply to bring the subject of the Congress to the notice of the scientific men of the world for advice and suggestions as to the general conduct of the convention, and in particular as to the scientific questions to be discussed. Recommendations of themes to be discussed and of persons to present them are especially solicited from the members of the Advisory Council of the Astronomical Congress. The Advisory Councils constitute the non-resident branches of the Auxiliary Committees. Additions to these Councils will be made from time to time. Communications may be addressed to the Chairman of the General Committee, or to the Chairman of the proper Special Committee.

"It is expected that men eminent in special lines of research will be invited to furnish papers on the leading topics under consideration. The suggestions and recommendations invited will be used in the formation of the programme for the Congress.

"The Chairmen of the Special Committees of the several chapters under the charge of the General Committee are as follows:—

"*On Pure Mathematics*: Professor E. H. Moore, Chicago University, Chicago, Ill.

"*On Astronomy*: Professor G. W. Hough, Dearborn Observatory, North-western University, Evanston, Ill.

"*On Astro-physics*: Professor Geo. E. Hale, Kenwood Astrophysical Observatory, Chicago, Ill.

" George W. Hough, Chairman.
" Elias Colbert, Vice-Chairman.
" E. H. Moore.
" George E. Hale.
" G. A. Douglas.
" Malcolm McNeill.
" R. W. Pike.
" Geo. C. Comstock.
" W. W. Payne.

" Committee of the World's Congress Auxiliary on a Congress of Mathematicians and Astronomers.

"*World's Congress Headquarters, Chicago, March* 1892."

Erratum in Annual Report February 1892.

The Mr. Henry Lord Boulton, of Carácas, Venezuela, whose death was recorded among the obituaries of Fellows who had died during the year 1891 (*Monthly Notices*, vol. lii. page 212), was not a Fellow of the Society. His son, also Mr. Henry Lord Boulton, of the same address, was elected 1889 January 11.